THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

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"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

"   . . .. per litora spargite muscum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hic carpite flores:
Floribus et pictam divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."

N. Parthenii Giannettasii Ecl. 1.

No. 97. JANUARY 1886.

I.—*On a living Spinose* Rhynchonella *from Japan.* By the late THOMAS DAVIDSON, LL.D., F.R.S.

[INTRODUCTORY.—The material for this paper was found on Dr. Davidson's table after his death, with a wood-block drawn from his own illustrations. In accordance with his wishes I have prepared for press the following short notice of this new and most interesting recent Brachiopod, the last he was destined to figure and describe, for death put an end to his life-long labours on the Brachiopoda on October 14.

Dr. Davidson intended this paper for the 'Annals and Magazine of Natural History,' and it now seems peculiarly fitting that it should be published in the periodical which issued his first important memoir on the group, that "On the Classification of the Brachiopoda" (vol. ix. 2nd series, 1852), just thirty-three years ago.—AGNES CRANE.]

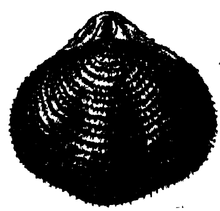
Rhynchonella Döderleini, Dav., n. sp.

Shell transversely subpentagonal, wider than long, hinge-line obtusely angular. Dorsal valve deep, posteriorly uniformly convex, anteriorly divided into three lobes, the central one forming a broad, rounded, mesial fold, varying in elevation according to the age of the individual. Ventral valve much less deep than the dorsal one, with a broad mesial sinus of greater or lesser depth commencing at a third of the length of the shell and extending to the front. Beak moderately produced, almost erect, with an oval-shaped foramen situated under its gently incurved angular extremity and margined by narrow deltidial plates. Lateral margins of the valves

slightly sinuated and forming in front a more or less elevated curve. Surface of valves marked with numerous delicate radiating ribs, with interspaces between them of almost equal width, and increasing in number at variable distances from the beak by the interpolation of shorter riblets. Ribs numbering in full-grown specimens sixty, close to the margin. Valves closely crossed by numerous equidistant concentric raised or foliated lines of growth, giving rise at the margin on each riblet to short, sloping or erect, hollow spinules. Shell-structure fibrous, colour light yellowish grey. In the interior of the dorsal valve are two short curved lamellæ for the support of the labial appendages. Length 12, breadth 13, depth 7 lines *.

In the young state the shell is much flatter, without a mesial fold, the ribs are fewer in number, and the spines have not yet become developed. Number of ribs about thirty, half of which originate from the interpolation of shorter ones between the others; some are also due to bifurcations.

Habitat. Several specimens of this new and interesting species were dredged by Dr. L. Döderlein in the living state in about 160 fathoms in Sagami Bay, Japan. *R. Döderleini* is often found attached to corals. It was associated with Hexactinellidæ, the crab *Lithodes hystrix*, *Laqueus rubellus*, *Ter. Blanfordii*, and *T. caput-serpentis*. I am informed by Dr. Döderlein that it was dredged close by "station 232" of the 'Challenger' Expedition, but a little nearer the coast, in from 100 to 250 fathoms. The sea-bottom was covered with mud, stones, and volcanic débris, and was rich in animal life †.



A

B

A. Adult *Rh. Döderleini*, Dav.

B. Portion of external surface enlarged, to show ribs, interspaces, concentric lines, and spines.

Observations.—In this very remarkable species, by far the most noteworthy of all the living members of the Rhynchonellidæ, the spines project from each rib. They are arranged in regular rows, and not irregularly scattered over the surface of the shell, as in *Rh. spinosa*, a some-

* [Dr. Davidson's description verbatim.—A. C.]

† No less than thirty-two species of Brachiopoda have now been obtained from Japanese and Chinese waters.

what similar form from the Inferior Oolite of Dundry and elsewhere. That species and its allies, *R. bradfordiensis* and *R. Crossi*, are profusely covered with longer spines, which appear to be a characteristic of age, as they are not so developed in young specimens. *R. Döderleini* therefore exhibits an interesting survival of a form of shell-ornamentation which formerly prevailed among the Palæozoic Productidæ, Orthidæ, &c., and the Oolitic Spiriferidæ and Rhynchonellidæ. No spinose Brachiopoda are known from the Cretaceous or Tertiary period, and the species now described is the first example of the kind among living species of the group.

I have named *Rh. Döderleini* after its discoverer, Dr. L. Döderlein, of the Naturhistorisches Museum of Strassburg, who kindly placed the specimens he dredged in Sagami Bay, Japan, at my disposal for description and illustration.

THOMAS DAVIDSON.

II.—*An Account of the Earth-Snakes of the Peninsula of India and Ceylon.* By Colonel R. H. BEDDOME, F.L.S.

Uropeltidæ.

Body cylindrical, with a small head, not distinct from the neck; eye very small or moderate. Cleft of the mouth of moderate width; teeth small in the maxillary and mandibular bones, none in the palate; only one pair of frontals, four upper labials; a longitudinal fold at the chin only in *Melanophidium*; tail very short, truncated, and terminating in a rough shield, which is rounded, square and more or less bicuspid, or flat with the caudal scales more or less keeled; or somewhat tapering, with a small terminal scute, which is 1–2-pointed, or with a horizontal ridge, with the caudal scales often quite smooth; anal bifid.

The species of this tribe are confined to the peninsula of India and Ceylon and are peculiar to the mountainous districts or to the heavy forests at the immediate foot of the mountains; their headquarters are the western ranges of mountains from Canara to Cape Comorin, only one species having been found on the mountains of the east coast, and only three north of the Kudra Mukh in South Canara, on the west side; some few only are widely distributed, others are exceedingly local and appear to be very rare in their localities.

They burrow into the ground, and are often dug up about coffee- and tea-estates; but they can always be collected by

turning over logs and large stones in the forests, and even on the grass-land at high elevations, and during the rainy season they are not unfrequently found about the roads. They are generally of small size, about 1 foot long, with a girth of scarcely 1 inch; the maximum length as yet known is 24 inches (a specimen of *Silybura grandis*), the maximum girth 3 inches (*Uropeltis grandis*). They never attempt to bite, however much they may be handled or teased; they will at once twine themselves tightly round a stick, and can be carried along without their attempting to escape. They are all ovo-viparous; they live almost entirely upon earth-worms. The eye is generally exceedingly small and lies well within the margin of the ocular shield (which is formed by the confluence of the supraorbital and postocular); it is only in *Platyplectrurus* that the eye can be said to be distinct and to have a post-ocular as well as a supraorbital, for, although there is a supra-orbital in *Plectrurus* and in *Teretrurus*, the ocular shield is more or less produced round and underneath the eye, and cannot be strictly called a postocular. *Melanophidium* shows an approach to the Calamaridæ in the longitudinal fold at the chin, and *Platyplectrurus* shows a still nearer approach in its broad head, the situation of the eye, and the arrangement of the surrounding shields, so that the tribe Uropeltidæ will probably not be allowed to stand unless it be only for the genera with the truncated tail. Many of the species are beautifully coloured with red and yellow when alive; the yellow colour always, and the red sometimes, fades to white in spirits. Green and blue colours are never present, but many of the species, particularly of the genus *Melanophidium*, have a most lovely iridescence when held in a certain light, and the violet and blue tints are very beautiful.

I have had many of the commoner species for long periods in captivity in boxes of earth, feeding them on earth-worms; but I have never known them to breed in captivity.

Synopsis of the Genera.

Tail truncated.

The caudal shield rounded, scaleless, the caudal scales generally smooth . . . . RHINOPHIS.

The caudal shield large, flat, scaleless . . . . UROPELTIS.

The terminal scute square at the end or bicuspid, the points side by side; the caudal scales generally strongly keeled . . . . SILYBURA.

The terminal scute vertically compressed, the points superposed. . . . . PLECTRURUS.

Tail tapering.

The terminal scute a single sharp point; no median groove along the chin . . . . TERETRURUS.

The terminal scute a single sharp point or furnished above with two parallel ridges, which are pointed at the end; a median groove along the chin .. .. MELANOPHIDIUM.
The terminal scute, at least in the male, ending in a horizontal ridge; no median groove.... PLATYPLECTRURUS.

RHINOPHIS, Hemprich.

(*Dapatnaya*, Kelaart; *Mytilia*, Gray.)

Tail cylindrical, very short in the female, rather longer in the male, terminating in a rounded scaleless rough shield, the caudal scales smooth, but sometimes with faint traces of keels; head conical, rostral acutely pointed, produced back, and separating the nasals; eye always very small, lying in the front part of the ocular shield and well within the margin; the first pair of lower labials generally form a suture behind the median shield, followed immediately by the first ventral; a pair of chin-shields sometimes present. No supraorbital. No mental groove. Scales round the middle of the body in 17, rarely in 15 rows.

Hab. Ceylon and South India.

Synopsis of the Species.

Caudal shield in extent equal to the head.
  Rostral very long, with distinct keel above.
    Colour nearly uniform .... *oxyrhynchus.*
    Much dotted.......... .... *punctatus.*
  Rostral shorter, without distinct keel.
    No red markings (Ceylon species).
      Ventrals 156–176. .... *planiceps.*
      „ 191–202.......................... *Trevelyanus.*
    Belly red (South-Indian species) .... *sanguineus.*
Caudal shield much smaller than the head .... *Blythii.*

Rhinophis oxyrhynchus.

Typhlops oxyrhynchus, Schneider, Hist. Amph. ii. p. 341.
Rhinophis oxyrhynchus, Hemprich, Grundr. Naturg. p. 119; Dum. & Bibr. vii. p. 154; Peters, Uropelt. p. 9, tab. 2. fig. 1; Gunther, Rept. of Brit. Ind. p. 184.
Dapatnaya lankadivana, Kelaart, Prod. ii. p. 16.
Mytilia unimaculata, Gray, Proc. Zool. Soc. 1858, p. 264.

Snout acutely pointed; rostral about half as long as the head, compressed, and furnished with a distinct longitudinal keel above; caudal shield large, obtusely rounded, extending to the lower surface of the tail, its extent equal to that of the head; all the caudal scales quite smooth both on the upper and lower surface of the tail; the first pair of lower labials scarcely meet behind the median, but there is a pair of chin-

shields (often unequal) between them and the first ventral. Scales round the middle of the body in 17 rows; ventrals not much larger than the adjoining scales, from 214 in the males to 223 in the females; subcaudals 7 or 8 in the males, 5 or 6 in the females, generally in pairs, but often some of them single. Adults up to about 15–17 inches in length, with a girth of about 1⅛–1⅜ inch. Body and belly nearly uniform brown, each scale with a lighter margin, some yellow markings about the tail.

Hab. Ceylon, Central Provinces.

Rhinophis punctatus.

Rhinophis punctatus, J. Muller, Treviran. Zeitschr. Phys. iv. p. 248; Dum. & Bibr. vii. p. 157; Peters, Urop. p. 12, tab. 3.
Pseudotyphlops oxyrhynchus, Schl. Abbild. p. 43, t. 12.

Snout acutely pointed; rostral about half as long as the head, compressed and furnished with a distinct longitudinal keel above; caudal shield large, obtusely rounded, extending to the lower surface of the tail, its extent being equal to that of the head; all the caudal scales quite smooth both on the upper and lower surface of the tail; the first pair of lower labials do not form a suture behind the median shield, but a pair of chin-shields, often unequal in size, form a suture between the median and the first ventral. Scales round the middle of the body in 17 rows; ventrals not much larger than the adjoining scales, 228 to 246 without reference to sex (a male with 9 subcaudals having 246, and a female with 6 subcaudals 240). Subcaudals 8 or 9 in the males, 6 or 7 in the females; the caudal scales faintly keeled. Length of adults up to 15–18 inches, with a girth of ⅞–1 inch. Yellowish in colour, each scale with a blackish or brown central spot, the scales in the series adjoining the vertebral series without spot.

Hab. Ceylon, Central Provinces; in the neighbourhood of Kandy, under stones.

Rhinophis planiceps.

Typhlops philippinus, Cuv. Règne Anim. ii. p. 74.
Rhinophis philippinus, Mull. Trev. Zeitschr. Phys. iv. p. 249; Dum. & Bibr. vii. p.154, t. 59. fig. 1; Peters, Uropelt. p 15; Jan, Icon. Générale des Ophidiens.
Rhinophis planiceps, Peters, Uropelt. p. 17, fig. 9.

Snout acutely pointed; rostral less than half the length of the head, quite flat or scarcely compressed above; caudal shield large, obtusely rounded, extending to the lower surface of the tail, its extent being about equal to that of the head; some of the caudal scales, both on the upper and lower surface

of the tail, with faint traces of keels both in males and females, but fainter in the latter, some of those along the central row on the upper surface often much enlarged; no chin-shields between the first pair of lower labials and the ventrals. Scales round the middle of body in 17 rows; ventrals not twice as large as the adjoining scales, from about 154 in the males to 176 in the females; subcaudals 6 or 7 in the males, 3 or 4 in the females, generally in pairs, sometimes single. Length of adults 11–12 inches, girth about ¾ inch. Blackish brown or brown above, each scale with a lighter margin, a lighter colour below; a yellow band across the vent; sometimes some yellow blotches on the anterior portion of the trunk.

Hab. Ceylon, Central Provinces.

I have adopted Peters's later name, as the older one of *philippinus* was given on the erroneous supposition that this species was found in the Philippine Islands. The vertical shield does not afford a specific character in any species of *Rhinophis* or *Silybura*, as it differs as much in individuals of the same species as it does in different species; the supposed *planiceps* differs in no way from *philippinus.*

Rhinophis Trevelyanus.

Dapatnaya Trevelyana, Kelaart, Prodr. Fauna Zeyl. ii. p. 17.
Mytilia Gerrardi, Gray, Proc. Zool. Soc. 1858, pp. 58, 263, tab. 13.
Rhinophis homolepis, Hemprich, Grundr. der Nat.; Peters, Uiop. p. 14.

Snout acutely pointed; rostral shield much less than half the length of the head, slightly compressed into a keel above; caudal shield large, obtusely rounded, extending to the lower surface of the head, its extent being rather more than that of the head; all the caudal shields quite smooth both on the upper and lower surface of the tail; the first pair of lower labials form a suture behind the mental, but there are no chin-shields between these and the ventrals. Scales round the middle of the body in 17 rows; ventrals not much larger than the scales of the adjoining series, from about 191 in the males to 203 in females; tail very short, 5 subcaudals in the males and 4 in the females. Length of adults about 11–12 inches, with a girth of about 1 inch. Body blackish, with the margins of the scales lighter; belly cream-coloured, the sides with a series of triangular cream-coloured or whitish bands which do not meet across the back.

Hab. Ceylon, Central Provinces; in the vicinity of Kandy, under stones.

Rhinophis sanguineus.

Rhinophis sanguineus, Bedd. Proc. Zool. Soc. 1863, p. 227; Günther, Rept. Brit. India, p. 186.
Rhinophis microlepis, Bedd. *l. c.* cum icon. (young).

Snout acutely pointed; rostral one third as long as the head, slightly compressed, with an obtuse longitudinal keel above; caudal shield large, roughly lined, obtusely rounded, extending to the lower surface of the tail, its extent being about that of the head; caudal scales in the males smooth on the upper surface of the tail, 4–8 keeled on the lower surface, in the females smooth both above and below, scales of the central row along the upper surface of the tail often enlarged; a pair of chin-shields present between the first pair of lower labials and the ventrals. Scales round the middle of the body in 15 rows; ventrals twice as large as the scales of the adjoining series, a few near the anal region in the male keeled (as are often some of the adjoining scales of the body), from 197 to 209 without reference to sex (a male with 9 subcaudals having 209, a female with 6 subcaudals, 204). Subcaudals 9 or 10 in the males, 5 or 6 in the females, generally in pairs, sometimes a few entire. Length of adults 16–17 inches, girth up to $1\frac{3}{8}$ inch. Back uniform bluish black, belly and 3 or 4 outer series of scales bright red blotched with black; caudal shield black, with a red band on each side and sometimes a similar one down the centre (the red colours fade to white in spirit).

Hab. South India: Cherambady in the Wynad, at about 3000 feet elevation; on the Brumagherries (North Wynad), under stones, 3000 to 4000 feet elevation; Nellambur, in Malabar, dug up in the forests about the Government teak-plantations, about 500 feet above sea-level (but close under the mountains); the Anamallays; Tinnevelly and Travancore ghats.

This species has exactly the caudal disk of the Ceylon species of this genus; but it differs from them in having 15 rows of scales instead of 17, and in its much larger ventrals. It is a curious fact that only one species should have been found in Southern India when Ceylon possesses five; but the fact of its occurring almost throughout the South Indian Uropelt region is rather against the chance of other species being detected.

Rhinophis Blythii.

Rhinophis Blythii, Kelaart, Prodr. ii. p. 14; Peters, Uropelt. p. 17; Gunther, Rept. of Brit. Ind. p. 186, in part only.
Mytilia Templetonii, Gray, Proc. Zool. Soc. 1858, p. 268.

Snout acutely pointed; rostral much less than one half the length of head, very slightly compressed, generally produced

back to the middle of the frontals; caudal shield much smaller than in the other species, asperous, in extent less than one half the surface of the head, obtusely rounded, rarely with a small ridge down its centre. Some of the final caudal scales on the upper surface of the tail in both males and females with faint traces of keels, some of the central row on the upper surface often enlarged; no chin-shields between the first pair of lower labials and the ventrals. Scales round the middle of the body in 17 rows; ventrals not much larger than the scales of the adjoining series, from 145 to 156 in the males, and from 159 to 164 in the females. Subcaudals 7 pairs in the males, 5 or 6 pairs in the females. Length of adults up to 13–14 inches, girth 1⅞ inch. Body brown, belly and sides more or less mottled with yellow or with a yellowish band along the anterior portion of the trunk; a complete yellowish ring round the end of the trunk near the anal region, and generally several triangular yellowish blotches up the sides of the anterior portion of the trunk, but not meeting over the back.

Hab. Ceylon, Central Provinces; common about Kandy and elsewhere.

This appears to be the stoutest of all the species of this genus, being nearly 2 inches in circumference; it has been confounded with *Silybura melanogaster* by Dr. Günther, but it is much larger than that species, has a different caudal disk, and a different coloration; this and *Silybura melanogaster* appear to be the only species very common in Ceylon, and I took them both all over the Central Provinces, though never together; whereas I only found a single example each of *Rhinophis punctatus*, *R. Trevelyanus*, and *Uropeltis grandis*. I never found *Rhinophis oxyrhynchus* or *planiceps*.

Uropeltis, Cuvier.

Tail cylindric, obliquely truncated as if cut by a knife, the truncated portion flat, scaleless, rough; head conical, nasal shields forming a suture behind the rostral, no supraorbital; the first pair of lower labials form a suture behind the median shield and are followed by a pair of chin-shields. No mental groove.

Hab. Ceylon.

Uropeltis grandis.

Uropeltis philippinus, Cuv. Règne Anim. ii. p. 76; Dum. & Bibr. vii. p. 161, pl. lix. fig. 2; Peters, Uropelt. p. 20; Tennant's Ceylon, vol. i. p. 195.
Pseudotyphlops philippinus, Schlegel, Abbildungen, p. 44.
Uropeltis saffragamus, grandis, and *pardalis*, Kelaart, Prodr. ii. pp. 15, 16.
Uropeltis grandis, Günther, Rept. Brit. Ind. p. 188.

Snout pointed; rostral convex, produced behind, nearly as long as the vertical; ventrals not much larger than the scales

of the adjoining series, from 130 to 148, probably without reference to sex, or at least not more in the female than in the male (one with 5 subcaudals having 133; one with 6 having 138; one with 9 having 143); subcaudals 5 to 9 pairs; very faint traces of keels on some of the terminal caudal scales; scales in 19 rows round the middle of the body. Length of large adult 20 inches, with a girth of 3 inches. Back a metallic bluish brown, the lateral scales and ventrals brown with a broad yellowish margin.

Hab. Ceylon, Central Provinces.

There are only 19 rows of scales round the middle of the body in all the specimens in the British Museum. Schlegel and Günther have described it with 21.

SILYBURA.

(*Siluboura*, Gray; *Silybura*, Peters.)

Caudal disk flat, as if severed by a knife, or convex and ill-defined; the scales on the upperside generally furnished with very prominent keels, rarely smooth or nearly so, but faint keels are nearly always visible; terminal scute a horny horizontal scale, which is generally bispinous with the points side by side, more rarely square. Head more or less conical; nasal shields forming a suture behind the rostral, or more rarely separated by that shield; no supraorbital; no mental groove. Eye small or moderate, lying in the front part of the ocular shield; the first pair of lower labials generally form a suture behind the median shield, followed immediately by the first ventral, or in some cases a pair of chin-shields intervene between the lower labials and the first ventral. Scales in 19, 17, or 15 rows.

Hab. S. India and Ceylon.

Synopsis of Species.

Scales in 19 rows.
  Caudal disk flat, snout pointed.................... *Broughami.*
  Caudal disk convex.
    Not ocellated; ventrals 206–214 .... *grandis.*
    Ocellated; ventrals 164–185.................... *nigra.*
Scales in 17 rows.
  Caudal disk flat.
    Snout pointed.................................. *dindigalensis.*
    Snout obtuse.
      With red markings.
        Two broad red lines .... *rubrolineata.*
        Large red blotches....................... *rubromaculata.*
      Without red markings .... *nilgherriensis.*
  Caudal disk convex.
    Snout pointed.
      Ocellated.
        Ventrals 214 in males to 233 in females...... *ochracea.*

Ventrals 193 in males to 203 in females .... *ocellata.*
" 173 in males to 188 in females .... *linea.*
Not ocellated.
Ventrals 226 in females .... *macrorhyncha.*
" 188 in males to 194 in females ... *nitida.*
" 156 in males to 166 in females .... *melanogaster.*
Snout variable, pointed or obtuse; ventrals 147–184 .... *Elliotii.*
Snout obtuse.
Nasals not separated by rostral.
Without red markings .... *Petersi.*
With red blotches .... *maculata.*
Nasals separated by rostral.
Belly brown, with yellow blotches or crossbars.. *pulneyensis.*
Belly uniform yellow .... *Güntheri.*
Scales in 15 rows .... *macrolepis.*

* *Scales in 19 rows.*

|| *Caudal disk flat; snout pointed.*

Silybura Broughami.

Silybura Broughami, Bedd. Proc. Zool. Soc. Nov. 1878.
Silybura Levingii, Bedd. *l. c.*

Snout pointed; rostral longer than the vertical, vertically compressed into a sharp ridge, produced back, but not quite separating the nasals; eye very small; caudal disk flat (the scales generally more or less confluent), prominently 3–5-keeled (or with many more keels when confluent); the terminal scute rough, bicuspid, the points side by side; no chin-shields between the first pair of lower labials and the ventrals; ventrals about twice as large as the adjoining scales, from 196 in males to 228 in females; subcaudals about ten pairs in males and six pairs in females. Length about 16–17 inches, girth up to 1⅜ inch. Brown with a series of transverse wavy black blotches in which are present ocellated white spots, the sides with yellowish angular blotches; ventrals dark brown.

Hab. The Sirumallays, Madura district, 5000 to 5500 feet elevation; the Lower Pulneys 4000 feet elevation.

||| *Caudal disk convex: snout pointed.*

Silybura grandis.

Rhinophis grandis, Bedd. Madras Quarterly Journal of Medical Science, 1867, cum icon.
Silybura grandis, Günther, Proc. Zool. Soc. March 16, 1875.

Snout rather pointed; rostral one third to one fourth the length of the head, simply convex above, produced back, but only rarely quite separating the nasals, which generally form a suture behind it; eye very small, in front of ocular shield;

caudal disk convex, the terminal scute small, bicuspid, the points side by side; the caudal scales 2–7-keeled; the first pair of lower labials form a suture behind the median shield and are followed by a pair of chin-shields. Scales round the middle of the body in 19 rows. Ventrals about twice as large as the scales of the adjoining series, from about 200 in the males to 214 in the females; in the males about 12 or 13 of the last ventrals and the scales of the trunk adjoining have similar keels to those on the caudal disk; subcaudals keeled, 10 to 12 pairs in the males, 7 or 8 pairs in the females. Length of adults up to about 24 inches, and girth up to 1½ inch. Back brownish violet; belly with alternate yellow and dark violet cross bands.

Hab. Anamallay forests, above Ponachi, at an elevation of about 4000 feet; not uncommon.

Silybura nigra.

Silybura melanogaster, Günther, Proc. Zool. Soc. March 16, 1875, pl. xxxi. fig. B.
Silybura nigra, Bedd. Proc. Zool. Soc. Feb. 5, 1878.

Snout more or less pointed; rostral about as long as the vertical, sometimes produced back and quite separating the nasals, or sometimes the nasals form a suture behind the rostral; eye very small; caudal disk convex, not well defined, terminal scute small, bicuspid, the caudal scales more or less keeled, but not prominently, sometimes all quite glabrous except a few of the terminal ones, on which the keels are very faint; no chin-shields between the lower labials and ventrals. Scales in 19 rows round the middle of the body; ventrals twice as large as the adjoining scales, from about 164 in the males to 185 in the females; subcaudals (some often single) 9 or 10 pairs in the male, about 6 pairs in females. Length about 9–12 inches, girth nearly 1 inch. Body blackish or dark violet, very iridescent, with regular transverse rows of yellowish or ocellated spots; belly uniform blackish, the sides with a yellow band more or less broken up into spots, or the belly and sides pretty regularly banded with black and yellow.

Hab. The Pulneys and other ranges of hills in Madura and North Tinnevelly, 4000 to 5000 feet elevation. Not uncommon; it can always be found under the rocks between Shembanganoor and Kodiekarnal, though not nearly so common as *S. pulneyensis*, which abounds there.

The typical *S. melanogaster* of Günther has the rostral separating the nasals as in the Ceylon *Rhinophis* (but I have

specimens in which the nasals form a suture behind the rostral), fewer ventrals, the belly uniform blackish, and the spots on the back ocellated; in typical *S. nigra* the nasals form a suture behind the rostral, the ventrals are more in number, and the spots are not ocellated; further collections, however, have shown that these characters are not constant, and I believe that any herpetologist examining all the specimens in the British Museum would unite the two. Dr. Günther's name is the older, but is now occupied by a Ceylon species, as I have found it necessary to remove *Rhinophis melanogaster* to *Silybura.*

** *Scales in* 17 *rows.*

|| *Caudal disk flat.*

A. *Snout pointed.*

Silybura dindigalensis.

Silybura dindigalensis, Bedd. Proc. Zool. Soc. March 6, 1877, p. 167.

Snout pointed; rostral sharp (as in *Broughami*), produced back, but not separating the nasals; eye very small; caudal disk flat, the terminal scute rather large, square at the end, or terminating in two points side by side, the caudal scales prominently 3–8-keeled (or, where confluent, with many more keels); no chin-shields between the lower labials and the ventrals; the scales in 17 rows round the middle of the body; ventrals twice as large as the scales of the adjoining series, from 158 in males to 169 in females; subcaudals, 10 pairs in males, about 6 pairs in females, or some of them often single. Length 12–15 inches, by 1¾ inch in girth. Body yellowish, with an open net-pattern of black markings; belly blackish, with very irregular transverse bars of yellow; a yellow line runs along the labials and a short way along the sides of the trunk; tail yellow beneath.

Hab. Sirumallays, in the Madura district, 4000 to 5000 feet elevation.

The black markings have a tendency to form cross bars; but the spots are never ocellated as in *S. Broughami*, which it much resembles in colour; the head and tail are quite the same in both, but as it has only 17 rows of scales and the ventrals differ so considerably in number they must be regarded as distinct species.

B. *Snout obtuse.*

a. *With red markings.*

Silybura rubrolineata.

Silybura rubrolineata, Bedd., Gunther, Proc. Zool. Soc. March 16, 1875, p. 228.

Snout obtuse, with the head and tail, chin-shields, &c. exactly as in *nilgherriensis*; ventrals 164 to 170. Colour uniform brown above and below; a broad bright red band along each side.

Hab. Travancore hills and Anamallays.

The typical specimen is from the Travancore hills and has a broad unbroken red band along each side, 164 ventrals and 6 subcaudals; the other two specimens in the British Museum are from the Anamallays, one with 170 ventrals and 8 subcaudals, the other with 165 ventrals and 6 subcaudals (so that *the number of ventrals has no reference to sex, as is the case in S. nilgherriensis*), *and they differ from the type in having* the lateral bands less distinct or more or less broken up into blotches.

Silybura rubromaculata.

Silybura rubromaculata, Bedd. Madras Quart. Journ. of Medical Science, 1867, cum icon.; Gunth. Proc. Zool. Soc. March 16, 1875.

Snout obtuse, the head, tail, chin-shields, &c. exactly as in *S. nilgherriensis*; ventrals 127 to 135, without reference to sex; subcaudals 9 or 10 in the males, 6 in the females. Length about 12–13 inches, girth about 1¼ inch. Colour brownish; a portion of each scale dull yellow, the yellow colour predominating on the belly and sides; five larger blood-red blotches along the sides of the anterior portion of the trunk, and one on each side of the tail near the vent.

Hab. Anamallays, in the forests above Ponachi, 4000 feet elevation.

This and the last are perhaps only varieties of *S. nilgherriensis*; but I have kept them distinct on account of the red colouring, there being no trace of that colour in hundreds of *S. nilgherriensis* that I have examined from time to time.

b. *Without red markings.*

Silybura nilgherriensis.

Uropeltis ceylanicus, Cuvier.
Coloburus ceylanicus, Dum. et Bibr.

Silybura nilgherriensis, Bedd. Proc. Zool. Soc. 1863, p. 220, pl. xxvi. fig. 1.
Silybura bicatenata, Günther, Reptiles of Brit. Ind. p. 191.
Silybura brevis, Günther, Ann. & Mag. Nat. Hist. 1862, p. 56; and Reptiles Brit. Ind. p. 192.
Silybura Elliotti, Günther, Rept. of Brit. Ind. p. 190 (in part).
Silybura ceylanica, Günther, Proc. Zool. Soc. March 16, 1875.

Snout obtuse; rostral shield rounded, quite flat, shorter than the vertical; nasals forming a suture behind the rostral; eye rather large; caudal disk flat, well defined, as if cut off at an angle with a knife, about as long as the tail; the terminal scute broad, more or less bicuspid, sometimes very sharply so, the caudal scales very prominently 1–3-keeled; the first pair of lower labials form a suture behind the median, followed by a pair of chin-shields. Scales round the middle of the body in 17 rows; ventrals twice as large as the adjoining scales, 122 to 142 (155 in two specimens from Bombay presidency), without reference to sex; subcaudals, about 12 pairs in males and 6 pairs in females. Length of largest adult 19 inches, girth 2¾ inches (but this is exceptionally large). *Colour generally brown or blackish brown above, the belly* more or less yellowish, or with a more or less distinct lateral yellow band; a broad yellow band on each side of the tail, which latter is black down the centre.

Hab. Nilgiris Mountains, from 3000 to 7000 feet elevation; and, I believe, throughout the Uropelt region of the western coast of the peninsula, and extending up into the mountains of the Bombay presidency, but not found on the mountains of the east coast or in Ceylon.

The name *ceylanica* cannot be kept up, as the species is not found in Ceylon.

Var. β. *Shortii.*

Silybura Shortii, Bedd. Proc. Zool. Soc. 1863, p. 225, pl. xxv. fig. 1.

The back ornamented with more or less regular yellow cross bars.

Hab. Shevaroy Hills, Salem district; the Anamallays.

Var. γ. *annulata.*

Body violet-brown, encircled with about thirty complete transverse rings of a darker shade; belly yellowish. (Ventrals 133, subcaudals 10 pairs in the unique specimen.)

Hab. The Wynad, Malabar, 3500 feet elevation.

Var. δ. *myhendræ.*

Colour slaty purple above, with the posterior third of each

scale yellowish; 3 or 4 dark triangular blotches on the anterior portion of the trunk and 1 or 2 similar ones about the anal region; belly yellowish, blotched with seaweed-like purplish markings. (Ventrals 139 to 141, subcaudals 7 pairs in the two specimens known.)

Hab. South Travancore, on the Myhendra Mountain.

A very beautiful variety, but not differing from the type in any way but coloration.

Var. ε. *arcticeps.*

Silybura arcticeps, Günther, Proc. Zool. Soc. March 16, 1875, p. 229.
Silybura madurensis, Bedd. Proc. Zool. Soc. Nov. 5, 1878, p. 802.

Brown or blackish purple above; belly and sides of the same colour, with irregular yellowish cross bars. (Ventrals 128 to 149, subcaudals 7 to 9 pairs.)

Hab. Mountains in the Madura district above the Cumbum valley; mountains of North Tinnevelly, 4000 to 6000 feet elevation.

The typical *arcticeps* of Günther (two specimens) has 128 to 130 ventrals; *madurensis* (Bedd.) 142 to 149; they are, however, I believe identical.

Var. ζ. *picta.*

Back blotched with orange-yellow and black, the two colours nearly equally divided, some scales being black and some yellow, others half black and half yellow; belly and sides (2 or 3 rows of scales) jet-black, iridescent, with very irregular broad orange-coloured blotches or cross bars.

Hab. North Travancore near Peermede.

A single example only of this most beautifully coloured variety was captured on Mr. Maltby's coffee-estate at an elevation between 3000 and 4000 feet; it has 150 ventrals and 8 pairs of subcaudals (the two central ones being single).

Some herpetologists will probably consider these five varieties distinct species; they, however, I believe differ only in coloration, and are, I think, only geographical varieties, though probably quite permanent as such in their respective localities.

Dr. Günther described *S. brevis* as a distinct species on account of its shorter form and fewer ventrals, 122 to 131 against 139 to 155 in what he considered typical of this species; I found out in India, however, that it was quite impossible to draw a line between them or to distinguish *S. brevis* in any way: the ventrals vary from 122 to 140, the coloration is exactly the

same, and they are found indiscriminately over the same area. The two specimens with 155 ventrals are both from the Bombay presidency (collected by Dr. Leith probably at Matheran); I have never counted so many, or more, I believe, than 142, in the type form, and these two specimens also differ in wanting chin-shields, so that it is probable that this Bombay form will have to be considered a seventh variety. The two specimens are poor, and more are required to settle this satisfactorily; I shall not be surprised, however, if some herpetologists unite *rubrolineata*, which has up to 170 ventrals, with this species.

‖‖ *Caudal disk convex.*

A. *Snout pointed.*

a. *Ocellated.*

Silybura ochracea.

Silybura ochracea, Bedd. Proc. Zool. Soc. Nov. 1878, p. 801.
Silybura Dupeni, Bedd. *l. c.*

Snout pointed; rostral moderate; nasals forming a suture behind the rostral; eye very small; caudal disk more or less convex, the terminal scute much broader than long, ending in two points side by side, the caudal scales 3–8-keeled; the first pair of lower labials form a suture behind the median, followed by a pair of chin-shields; scales in 17 rows round the middle of the body; ventrals twice as large as the adjoining scales, 214 to 233, without reference to sex. Subcaudals about 10 pairs in the males, 6 pairs in the females. Length of largest adults about 20 inches, girth $1\frac{1}{8}$ inch. Back yellowish in life (yellowish brown in spirits), in the half-grown and young purplish brown; irregular cross bars of ocellated spots, which are yellow, with a black ring; sides and belly yellow, but the latter much mottled and blotched irregularly with the ground-colour; tail dark-coloured beneath, surrounded by a bright yellow band.

Hab. Anamallays, about Nelliampady, on the Cochin side, at 3000 feet elevation; also above Ponachi, on the Coimbatore side of the same hills, 4500 feet elevation; also the Bolampatty hills, near Coimbatore, 2000 feet elevation.

Silybura ocellata.

Silybura ocellata, Bedd. Madr. Quart. Journ. of Med. Scien. 1863, cum icon.; and Proc. Zool. Soc. June 9, 1863; Gunther, Proc. Zool. Soc. March 16, 1875.

Snout pointed; rostral much shorter than the vertical,

slightly compressed; nasals forming a suture behind the rostral; eye very small; caudal disk convex, twice as long as broad, the terminal scute more or less bicuspid, the caudal scales prominently 3–4-keeled; the first pair of lower labials form a suture behind the median, followed by a pair of chin-shields; scales in 17 rows round the middle of the body; ventrals twice as large as the adjoining scales, from 193 in males to 203 in females; subcaudals, 10 pairs in males, about 8 in females (sometimes entire). Length 10–15 inches, girth $\frac{7}{8}$–1 inch. Colour of the male yellowish, yellowish brown towards the head and tail; female dull brownish; young purplish brown: all banded with rather irregular close-set transverse series of yellow black-edged ocelli; a series of yellow transverse bands along each side or right across the belly corresponding to the ocellated bands.

Hab. Nilgiris, western slopes below Sispara, about 3500 feet elevation, in dense moist forests; Tinnevelly Hills.

Silybura liura.

Silybura liura, Gunther, Proc. Zool. Soc. March 16, 1875, pl. xxxi. fig. A.

Snout rather pointed, but more obtuse than in *S. ocellata*; rostral very short; nasals forming a suture behind the rostral; eye very small; caudal disk very convex above, terminal scute small, bicuspid; the caudal scales smooth, except very inconspicuous keels on some of the final ones; the first pair of lower labials form a suture behind the median, followed by a pair of chin-shields; scales round the middle of body in 17 rows; ventrals twice as large as the adjoining series, from 173 in males to 188 in females; subcaudals about 12 pairs in males, 8 in females. Length of adults 10–13 inches, girth $\frac{7}{8}$–$1\frac{3}{8}$ inch, the females the stouter. Colour purplish brown, with transverse series of ocellated small yellow spots; belly and sides (2 or 3 outer rows of scales) with numerous irregular yellow cross bars.

Hab. Tinnevelly and Madura Hills, 3000 to 5000 feet elevation.

Two males in the British Museum have 173 and 183 ventrals and 12 subcaudals; a female has 188 ventrals and 8 subcaudals; the coloration is that of *S. ocellata*, and it only differs, besides having rather fewer ventrals, in the rostral being more obtuse and in the caudal scales being much smoother, neither of which characters may prove to be constant, and it may have to be united with the preceding species.

b. *Not ocellated.*

Silybura macrorhyncha.

Silybura macrorhyncha, Bedd. Proc. Zool. Soc. March 6, 1877.

Snout sharply pointed; rostral nearly ¼ inch long, very acute and compressed into a sharp ridge; nasals large, very oblique, broad below, very narrow upwards, and only just meeting behind the rostral; eye very small; vertical square in front, shield-shaped and three-sided; caudal disk more or less convex, terminal scute large, bicuspid, the points side by side; the caudal scales prominently 4–5-keeled; no chin-shields, and the first pair of lower labials do not form a suture behind the mental. Scales round the middle of body in 17 rows; ventrals twice as large as adjoining series, 226, with 6 pairs of subcaudals (female). Length 22 inches, with a girth of 1¼ inch. Colour uniform brown, but somewhat paler below; a lateral yellow band along the anterior portion of the trunk for a short distance, commencing at the fourth labial; tail black below, with a yellow band on each side.

Hab. Anamallays, dense forests above Ponachi, at an elevation of 4000 feet. A unique specimen in the British Museum.

The coloration is quite that of *S. Elliotii*, and when I first found it I set it down as a very large form of *S. Beddomei*; but its much larger size, its very long and sharp rostral, and the much greater number of ventrals make this, I think, almost impossible.

Silybura nitida.

Silybura nitida, Bedd. Proc. Zool. Soc. Feb. 5, 1878.

Snout scarcely pointed; rostral very small, sometimes somewhat compressed and pointed, not separating the nasals; eye very small; caudal disk convex, terminal scute square or bicuspid, the caudal scales slightly keeled; no chin-shields between the first pair of lower labials and the ventrals. Scales in 17 rows round the middle of the body; ventrals twice as large as the adjoining scales, from 185 to 194, without reference to sex; subcaudals, in the males 12 pairs, in the females 5 or 6 pairs. Length up to about 14 inches, girth about 1¼ inch. Colour nearly jet-black, but very iridescent; the belly (ventrals and 2 or 3 outer rows of scales) with very distant, broad, bright yellow blotches, which sometimes meet and form cross bars, the black colour much predominating.

Hab. The Anamallays, about the Nelliampady estates on the Cochin side, elevation 4000 to 5000 feet.

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Silybura melanogaster.

Rhinophis melanogaster, Peters, Monogr. p. 18, tab. ii. fig. 4.
Mytilia (*Crealia*) *melanogaster*, Gray, Proc Zool. Soc. 1858, p. 204.
Plectrurus ceylonicus, Peters, Monatsber. Berl. Acad. 1859, p. 388.
Rhinophis Blythii, Gunther, Rept. of Brit. Ind. (in part only).

Snout rather pointed; rostral small, flat or very slightly compressed, nearly as long as the vertical, separating the nasals, but not reaching to the middle of the frontals, or in some cases only barely touching those shields; eye very small; caudal disk convex, terminal scute small, generally more or less bicuspid, with the points side by side, sometimes square at the end; faint traces of keels are generally present more or less on the scales of the lower surface of the tail, and sometimes on a few of the terminal ones of the upper surface, and these traces are clearer in the males than in the females; no chin-shields between the first pair of lower labials and the ventrals. Scales in 17 rows round the middle of the body; ventrals only a little larger than the adjoining scales, about 154 to 156 in the males, and 162 to 166 in the females; subcaudals 9 to 12 in the males, 4 to 6 in the females. Length 10–12 inches, girth $\frac{7}{8}$ inch to 1 inch. Back and belly brownish or blackish; a more or less perfect yellowish lateral streak along each side; no transverse band in front of tail.

Hab. Ceylon, central provinces, about Kandy and Peradenia and elsewhere, very common.

This species has generally been placed in the genus *Rhinophis*; the terminal scute of the tail is, however, quite that of *Silybura*, the separation of the nasal shields by the rostral is not a generic character peculiar to *Rhinophis*, as it occurs also in *S. pulneyensis* and *Güntheri*, and occasionally in *S. grandis* and *nigra*; again, the male of this species has a greater number of subcaudals than ever occurs in any of the species of *Rhinophis*, but agrees in this respect with *Silybura.*

B. *Snout variable.*

Silybura Elliotii.

Siluboura ceylonicus, Gray, Cat. of Lizards, p. 142, excl. synonym.
Siloboura Ellioti, Gray, Proc. Zool. Soc. xxvi. p. 262 (1858).
Silybura Elliotti, Gunther, Reptiles of Brit. India, p 190, in part (the male specimens); Günther, Proc. Zool. Soc. March 16, 1875, p. 228.
Silybura Beddomei, Günther, Rept. Brit. India, p. 190, and Proc. Zool. Soc. *l. c.*
Silybura punctata, Gunther, Proc. Zool. Soc. *l. c.* p. 229.

Snout pointed or more or less obtusely conical; rostral varying in length and often compressed into a slight keel, not separating the nasals; eye small; caudal disk convex, the

terminal scute small, bicuspid or square at the end, the caudal scales rather strongly 2–5-keeled; no chin-shields between the first pair of labials and the ventrals; scales in 17 rows round the middle of the body; ventrals nearly twice as large as the scales of the adjoining series, 147 to 189, without reference to sex; subcaudals about 10 pairs in the males and 6 in the females. Length about 10–12 inches, with a girth of about 1 inch. Colour generally uniform brown, with a yellowish line along each side of the neck; anal region with a broad yellow band, and a more or less perfect lateral yellow band along each side of the tail excurrent from the cross band of the anal region; belly often somewhat blotched with yellow; sometimes the colour of the body is almost black with two yellow spots on each scale, or brown with similar spots (*punctata* of Günther), but the markings about the tail are always more or less present.

Hab. This is the commonest Uropelt in Southern India, and has by far the widest geographical range, being, I believe, the only one found in the mountains of the eastern coast (Cuddapa, Kurnool, and Vizagapatam); it is also common on the hills in the Salem district, on the Mysore tableland, and in all the western-coast mountains from North Canara southwards.

Silybura Beddomei was distinguished by Günther as having a more pointed snout; and *S. punctata* from *Beddomei* as having fewer ventrals as well as being spotted; but when collecting many specimens in India I could never satisfactorily distinguish between them. Of the specimens in the British Museum I find three specimens of *S. Elliotii* collected by myself in North Canara, in which two have the rostral rather pointed (ventrals 148 and 178), the other the rostral obtuse (ventrals 153). Two males from Vizagapatam mountains have 10 and 9 subcaudals and 168 and 176 ventrals, and a female has 6 subcaudals and 178 ventrals. The specimens labelled *Beddomei* have the rostral pointed (ventrals 178, 184, and 189), but the coloration exactly the same as in *S. Elliotii*. In *S. punctata* the rostral is always more or less pointed, though sometimes only very slightly, and the ventrals vary from 147 to 173, viz. 147 and 153 in two examples from the Pulney hills, 153 in one from the Anamallays, 173 in a female from Jeypore (near Vizagapatam), in which the rostral is much pointed and all but separating the nasals, and 169 in a male (11 subcaudals) from the same hills, whereas another from the adjacent hills of Golcoondah has only 153. The correct spelling is *Elliotii*, not *Elliotti*, as the species is named after Sir Walter Elliot, who first sent it home to the British Museum.

C. *Snout obtuse.*

a. Nasals not separated by the rostral.

a. *Without red marking.*

Silybura Petersi.

Silybura Petersi, Bedd. Proc. Zool. Soc. Feb. 5, 1878.

Snout obtuse; rostral very small, not separating the nasals; eye small; tail somewhat compressed, caudal disk convex, terminal scute very small, square at the end or shovel-shaped; caudal scales mostly quite smooth, a few of the terminal ones very inconspicuously 2–5-keeled; no chin shields between the first pair of lower labials and the ventrals. Scales in 17 rows round the middle of body; ventrals 155 to 160, without reference to sex; subcaudals 10 to 12 pairs in the males, about 6 in the females. Length 6–7 inches, girth ¾ inch. Colour uniform brown, sides with indistinct yellowish spots or narrow transverse bars, which sometimes extend across the belly, a broad yellowish band across the anal region (but no lateral bands as in *S. Elliotii*).

Hab. Anamallays, 4000 feet, in forests above Ponachi; rare.

This is not unlike *S. Elliotii* in coloration, except that it has not the lateral bands on the tail; it differs, however, much in the caudal disk.

b. *With red blotches.*

Silybura maculata.

Silybura maculata, Bedd. Proc. Zool. Soc. Feb. 5, 1878.

Snout obtuse; rostral rounded, very small, not separating the nasals, which are as large as the frontals; eye rather large; tail somewhat compressed; caudal disk convex; the terminal scute small, size of two scales only, square at the end or inconspicuously bicuspid, the points side by side, the caudal scales smooth, but a few of the terminal ones have faint traces of keels; no chin-shields between the first pair of lower labials and the ventrals; scales round the middle of the body in 17 rows; ventrals about twice as large as the scales of the adjoining series, about 155 in the males and 164 in the females; subcaudals 11 to 13 pairs in males, about 8 pairs in females (some of them often entire). Length 12–14 inches, girth about 1⅜ inch. Colour of a uniform dark brown or blackish, with several deep red blotches along the sides of the anterior portion of the trunk and about the tail, and rarely several are present along the sides of the trunk.

Hab. Anamallays, higher ranges 6000 to 7000 feet elevation. Not uncommon.

β. Nasals separated by rostral.

Silybura pulneyensis.

Plectrurus pulneyensis, Bedd. Proc. Zool. Soc. 1863, cum icon.
Rhinophis pulneyensis, Günther, Rept. of Brit. Ind. p. 187.
Silybura Wood-Masoni, Theob. Cat. Rept. of Brit. Ind. p. 135.

Snout rather obtuse; rostral flat, not compressed, rather broad behind, and completely separating the nasals; eye small; tail somewhat compressed; caudal disk convex; the terminal scute the size of three scales, bicuspid, the points side by side, the caudal scales smooth or generally a few of the final ones with faint keels; no chin-shield between the first pair of lower labials and the ventrals; scales in 17 rows round the middle of the body; ventrals nearly twice as large as the adjoining scales, 173 to 179, without reference to sex; subcaudals 12 pair in the males, 6 to 9 pair in females (or sometimes entire). Length 10–14 inches, girth up to 1½ inch, but seldom more than 1¼. Colour uniform earthy brown; a lateral bright yellow streak from middle of fourth labial continued for 1–1½ inch along the trunk; a few minute yellow specks on the back; belly with broad, bright yellow, transverse bands, very irregular as to number and shape; some yellow markings about the vent and tail.

Hab. Pulney hills (Madura district), 5000 to 7000 feet elevation. This is the common species on these hills, very abundant on the higher ranges, often found about the roads in wet weather, and dug up in gardens, also common on the short cut up from Shembaganoor under rocks, associated with *Silybura nigra* and *Platyplectrurus madurensis*.

The ventrals in this species are not more in the female than in the male, as is usually the case. A male with 12 subcaudals has 174 ventrals, and females with 9, 7, and 6 respectively have 177, 173, and 179 ventrals.

Silybura Güntheri.

Silybura Güntheri, Bedd. Proc. Zool. Soc. Nov. 5, 1873.

Snout broad, obtuse; rostral small, but quite separating the nasals; eye small; tail rather long, somewhat compressed; the terminal scute square at the end, slightly bicuspid, the points side by side, all the caudal scutes perfectly smooth; no chin-shields between the first pair of lower labials and the ventrals; scales in 17 rows round middle of body; ventrals much larger than the adjoining scales, 168; subcaudals 13 pairs. Body uniform purplish black, iridescent; belly and the 1 or 2 adjoining rows of scales yellow; chin and the first

inch or so of the belly black; tail black beneath, but with a yellow band on each side; upper labials and terminal scute yellow.

Hab Madura district, in moist woods on the "High Wavy," a mountain at the head of the Cumbum valley, at an elevation of about 5000 feet. Only a single specimen (now in the British Museum) is known, and not apparently adult; it is certainly rather abnormal in the genus, and when better known may have to be removed elsewhere.

*** *Scales in* 15 *rows.*

Silybura macrolepis.

Silybura macrolepis, Peters, Monatsber. Berl. Acad. 1861, p. 904; Günther, Rep. Brit. Ind. p. 189.

Snout obtuse; rostral shorter than the vertical, flat above, not separating the nasals; eye large; caudal disk flat, well defined (exactly as in *S. nilgherriensis*), twice as long as broad, prominently bicuspid; the caudal scales with 1 or 2 prominent keels; the first pair of lower labials form a suture behind the median shield, followed by a pair of chin-shields. The scales in 15 rows round the middle of the body, ventrals twice as large as the adjoining scales, 128 to 138 without reference to sex; subcaudals 8 or 9 pairs. Length about 1 foot, a large adult female being 1½ inch in girth, and a large male 1¼ inch. Colour violet or purplish black or brown, with yellowish blotches along the anterior sides of the trunk; tail yellowish on each side.

Hab. Bombay ghats; Matheran hills.

There are four specimens in the British Museum, three collected by Dr. Leith on the Matheran hills, the other without locality. Two females with 8 subcaudals have 131 and 134 ventrals, and one male with 9 subcaudals has 130 ventrals; it has quite the aspect and colouring of *S. nilgherriensis*, and might be taken for that species unless the rows of scales were counted; it appears to differ also in the number of subcaudals.

Plectrurus.

Plectrurus, Dum. & Bibr.
Maudia, Gray, Proc. Zool. Soc. 1858, p. 261.

Terminal scute of the tail much compressed vertically, horny, bicuspid, the points one above the other, single or double. Snout obtusely rounded, the nasals forming a suture behind the rostral; eye pretty large in the front part of the ocular shield; a supraorbital generally present, but wanting in one species. Scales round the body in 15 rows; generally

a pair of chin-shields separate the first pair of lower labials from the ventrals, but these are sometimes wanting.

Hab. South India.

Synopsis of Species.

A supraorbital present.
- Uniform brown .... *Perrotetii.*
- Each scale yellow, encircled with a black ring ...... *Davidsoni.*
- Reddish, with a yellow belly .... *Güntheri.*
- Golden, with black cross bars .... *aureus.*

No supraorbital .... *canaricus.*

Plectrurus Perrotetii.

Plectrurus Perrotetii, Dum. & Bibr. vii. p. 167, pl. lix. fig. 4; Günther, Rept. of Brit. Ind. p. 193.

Snout obtuse; rostral short, flat, rounded, as long as a nasal; vertical elongate, produced behind, much longer than broad; tail compressed; terminal scute compressed vertically and ending in two superposed points, which are single; the caudal scales keeled; the first pair of lower labials form a suture behind the median followed by a pair of chin-shields; scales round the middle of body in 15 rows; ventrals nearly twice as large as the adjoining scales, 153 to 162 without reference to sex; subcaudals 11 or 12 pairs in males, 6 or 8 pairs in females. Length of adults about 12–14 inches, with a girth of little over an inch; but exceptionally large specimens have been found with a girth of 1¾ inch, though not exceeding 14 inches in length. Colour uniform brownish, the belly a little paler; the young with small yellowish-white dots on the scales forming longitudinal lines.

Hab. Nilgiris mountains, 5000 to 8000 feet elevation. Very common about Ootacamund, where it can easily be found by turning over stones both on the grassland and in the woods; it is often dug up in gardens, and in wet weather is found crawling about the roads.

Plectrurus Davidsoni, n. sp.

Snout obtuse; rostral very small; nasals forming a suture behind the rostral; vertical large, much elongated behind, twice as long as broad; supraorbital small; occipitals large, much elongated; tail, terminal scute, and caudal scales as in *P. Perrotetii*; eye and chin-shields as in *P. Perrotetii*; ventrals nearly twice as large as the adjoining scales, 181 (in the unique specimen); subcaudals 8 pairs. Length 16½ inches, girth 1½ inch. Each scale yellow, more or less encircled with a black ring; ventrals blotched with black.

Hab. Anamallay hills, 4700 feet elevation. Collected by Mr. Davidson of Coonoor, and presented by him to the British Museum.

Nearly allied to *P. Perrotetii*, but its coloration is distinct and very pretty; it is besides a longer snake with a greater number of ventrals; it has much longer occipitals, but this may not be a constant character.

Plectrurus Güntheri.

Plectrurus Guntheri, Bedd. Proc. Zool. Soc. 1863, p. 228, pl. xxvii.; Gunther, Rept. Brit. Ind. p. 193.

Snout obtuse; rostral small, as long as broad, much shorter than a nasal; vertical elongate, produced behind, nearly twice as long as broad; tail compressed; the terminal scute tubercled, the two superposed points 2–3-pointed, or there are four superposed points; the caudal scales and some of the approximate scales of the trunk 3-6-keeled; the first pair of lower labials form a suture behind the median and are followed by a pair of chin-shields; scales in 15 rows round the middle of the body; ventrals nearly twice as large as the scales of the adjoining series, 171 to 175, subcaudals 10 to 12 pairs. Length 13–14 inches, girth about $1\frac{1}{8}$ to $1\frac{3}{8}$ inch. Body bright reddish purple; belly yellow, the yellow colour rising up on the sides of the trunk in triangular markings, the purple colour descending in the same form down to the ventrals.

Hab. Nilgiris hills, in the moist forests about Walaghat (halfway down the Sispara ghat), at an elevation of 3500 to 4000 feet; found under stones and rocks. Very rare, only five examples have been found.

Plectrurus aureus.

Plectrurus aureus, Bedd. Proc. Zool. Soc. March 2, 1880, p. 182.

Snout obtuse; rostral very small; vertical pointed behind; supraorbital about half as large as the postocular; eye large, occupying nearly half the ocular shield; tail compressed; the terminal scute with two double points, one above the other; the caudal scales and a few of the last scales of the trunk 3–7-keeled; the first pair of lower labials form a suture behind the median, a pair of chin-shields present or not; scales in 15 rows round the middle of the body; ventrals rather more than twice as large as the scales of the adjoining series, 164 or 165; subcaudals 12 pairs (in the two specimens known). Length about 14 inches, girth about 1–$1\frac{1}{8}$ inch. Of a brilliant

golden colour, brighter beneath; the scales edged with violet, with or without a few irregular narrow violet-black cross bars along the back; the belly much ornamented with broad violet-black cross bars, sometimes confluent; tail beneath with a violet-black blotch.

Hab. The Wynad (in Malabar), on the Chambra mountain. Only two examples were secured, and it has not been found elsewhere. One was at 6000 feet and the other at 4500, both in heavy forest, under old logs or stones; it is one of the most beautiful of the tribe, but the very brilliant golden colour soon fades in spirits.

Plectrurus canaricus.

Silybura canarica, Bedd. Madras Journ. of Med. Science, 1870.
Plectrurus canaricus, Gunther, Proc. Zool. Soc. March 16, 1875, p. 229.

Snout obtuse; rostral small, pointed behind and produced back, but not separating the nasals; vertical four-sided, produced back; no supraorbital. Eye in the front part of the ocular, but well within the margin; tail compressed; the terminal scute with two single superposed points; the caudal scales with 3–5 keels, or nearly quite smooth, the traces of keels being very faint or only on a few of the final scales; no chin-shields between the first pair of lower labials and the ventrals; scales in 15 rows round the middle of the body; ventrals not quite twice as large as the scales of the adjoining series, from 176 in the males to 188 in the females; subcaudals 6 pairs in the females, 11 or 12 pairs in the males. Length of adults up to about 16 inches, with a girth of 1½ inch. Brownish violet, very iridescent, each scale more or less blotched with yellow, often the anterior portion of the trunk variously streaked and blotched with yellow; a yellow band along each side of the tail and along the upper and lower labials.

Hab. South Canara; common on the Kudra Mukh, a mountain on the ghats near Mangalore, at a elevation of about 6000 feet; not met with elsewhere.

Mr. Theobald, in his 'Catalogue of Indian Reptiles,' describes a sixth species of *Plectrurus* as follows. This I have not seen.

Plectrurus scabricauda.

Scales in 15 rows; eye between 4 shields, frontal, superciliary, postocular, and third labial; nasals large; caudals 8 pairs; all the scales surrounding the tail and a few of the

last ventrals are roughened, with 1–2–3 tubercular keels; tip of tail flattened vertically, pustulose, simple, not cuspid; chin, tail, and body iridescent blackish brown, the ventrals and the adjoining row of scales yellow. Length 6·53 inches (tail 0·40 inch).

Hab. Anamallays.

TERETRURUS, new genus*.

Head obtusely conical, not so flat as in *Platyplectrurus*; snout obtuse, but not so rounded as in *Platyplectrurus*; eye rather large, occupying more than half of the ocular shield; a small supraorbital; a small temporal shield in conjunction with the ocular and between the fourth labial and the occipital; first pair of lower labials form a suture behind the median followed by a pair of chin-shields; scales round the middle of the body in 15 rows; tail very short in both sexes, and terminating in both in a single point; the caudal scales smooth or more or less keeled; no median groove along the chin; teeth small.

Hab. S. India.

Teretrurus sanguineus.

Plectrurus sanguineus, Bedd. Madr. Journ. of Med. Science, 1867, p. 14, with plate.
Platyplectrurus Hewstoni, Bedd. Proc. Zool. Soc. Nov. 7, 1876.

Snout obtuse; rostral very small, one third size of a nasal; frontals much larger than the nasals; temporal hardly more than half as long as the occipital; vertical six-sided, pointed behind; supraorbital not twice as large as the portion of the ocular not occupied by the eye; tail short, suddenly tapering, the terminal scute ending in a sharp point in both male and female; the caudal scales smooth in the female, a few of the terminal ones with very faint keels in the male; the first pair of lower labials form a suture behind the median followed by a pair of chin-shields; ventrals twice as large as the adjoining scales, 145 to 150 without reference to sex; subcaudals 7 or 8 in the male, 5 or 6 in the female. Length 6–8 inches, girth about $\frac{7}{8}$ inch. Colour blackish violet above; belly uniform red or often with a few violet-black blotches.

Hab. Anamallays, above Ponachi, elevation 4000 feet; very common.

Var. *β. Hewstoni.*

Ventrals 123 to 127 only, otherwise as in the type. Two specimens, one with 5 the other with 7 subcaudals.

Manantoddy (Wynad); elevation 2700 feet.

* τέρετρον an awl, and οὐρά.

Teretrurus travancoricus, n. sp.

Head as in *T. sanguineus*, which this species much resembles, but with the following differences:—Tail in the male with 7 to 9 subcaudals, the caudal scales being prominently keeled, as are also some of the last ventrals and adjoining scales; in the female, with 5 or 6 subcaudals, the caudal scales are smooth, or with very faint keels only on a few of the terminal ones; ventrals 130 to 135 without reference to sex. Length 7–8½ inches; the girth of adult males ⅞ inch, of females $1\frac{5}{16}$ inch, being a larger and stouter snake than *T. sanguineus*, and the females of much greater girth than the males. Colour brick-red or reddish brown above; belly red, very much blotched with black, or sometimes the belly is all black, with only a few small red markings.

Hab. The mountains between Travancore and Tinnevelly, above Paupanassum, 3000 to 5000 feet elevation; common, and easily found under large stones or decaying logs in these forests.

MELANOPHIDIUM.

Melanophidium, Günther, Rept. Brit. Ind. p. 193.

Tail tapering, slightly compressed, covered with smooth scales; the terminal scute small, smooth, horny, variable, ending in a single point slightly turned upwards, with or without a slight ridge down the centre of the scute, or with two parallel ridges above terminating in small points, generally side by side, or rarely superposed; snout obtuse; rostral small, simply convex; nasals forming a suture together behind the rostral; eye very small, in the front part of the ocular shield, well within the margin; no supraorbital; a median groove along the chin; the first pair of labials form a suture behind the median, followed by two pairs of chin-shields; the anterior large, the posterior pair small. Scales round the body in 15 rows; subcaudals 10 to 12 in females, 15 to 17 in males.

The snakes of this genus appear to be very rare, very few specimens having been found, though much search has been made in the localities they are known to inhabit. They are more beautifully iridescent than those of any other genus.

Hab. S. India.

Synopsis of Species.

All uniform black, or the belly with irregular yellowish or whitish blotches	*wynaudense.*
Black, a broad yellow streak on each side from snout to tail	*bilineatum.*
Black; belly and sides whitish, spotted with black	*punctatum.*

Melanophidium wynaudense.

Plectrurus wynaudensis, Bedd. Proc. Zool. Soc. June 9, 1863 (*wynandensis* by misprint).
Melanophidium wynandense, Gunther, *l. c.* p. 194.

Snout obtuse; rostral rather small, simply convex, as high as broad; nasals forming a suture behind the rostral; vertical hexagonal, longer than broad, pointed in front and behind; occipitals rather longer than vertical; caudal scales all quite smooth, terminal scute small, ending in a single point, or flattened above and square at the sides and ending in an upturned ridge. Scales round the centre of the body in 15 rows; ventrals nearly three times as broad as the scales of the adjoining series, 176 to 185 without reference to sex; subcaudals, 10 to 12 pairs in the females, 15 pairs in the males. Length of adults about 15–17 inches, girth about $1\frac{1}{4}$–$1\frac{3}{8}$ inch. Colour black, but most beautifully iridescent; generally some broad yellowish or whitish blotches on the belly, which are larger and more numerous towards the tail; but these are sometimes absent, and the whole snake is uniform black; tail uniform black.

Hab. The Wynad (Malabar), 3000 to 3500 feet elevation, very rare. Six only have been found, with ventrals and subcaudals as follows:—

4 females	10	subcaudals	and	185	ventrals.
	11	"	"	185	"
	12	"	"	176	"
	12	"	"	176	"
2 males	15	"	"	180	"
	15	"	"	179	"

Melanophidium bilineatum.

Melanophidium bilineatum, Bedd. Madr. Journ. Med. Science, Sept. 1870.

Snout obtuse; rostral rather small, broader than high; nasals smaller than the frontals; vertical hexagonal, pointed in front and behind; occipitals very elongate, much longer than vertical; eye very small, well within the margin of the ocular shield; caudal scales quite smooth, the terminal scute scarcely larger than one caudal scale, ending in a single point. Scales round the body in 15 series; ventrals three times as broad as the scales of the adjoining series, 184 to 200; anal large, bifid; subcaudals 15 to 17 pairs. Length up to about 14 inches; girth about $\frac{7}{8}$ of an inch. Colour of the belly and back uniform bluish black, very iridescent; a broad yellow streak from the snout to the tail on each side, which occupies the whole of the second row of scales from the ven-

trals and half of the first and third row, the scales in the second row each with a black dot in their centre; tail yellow underneath.

Hab. The Wynad (Malabar), in forests on the Peria Peak and on the Tirrhioot Peak, 4000 feet elevation. Only four examples were found, three adults and one young. Two adults with 15 subcaudals each have respectively 184 and 191 ventrals, and one adult with 16 subcaudals has 200 ventrals; the young one has 17 subcaudals.

Melanophidium punctatum.

Melanophidium punctatum, Bedd. Madr. Journ. Med. Science, Dec. 1871.

Snout obtuse; rostral shield rather small, simply convex, nearly as high as broad; nasals forming a suture behind the rostral; frontals much larger than nasals; vertical hexagonal, nearly as broad as long, with an obtuse angle in front and an acute one behind; eye very small, well within the margin of the ocular shield and about one fourth its size; caudal scales all quite smooth, the terminal horny scute 1½ to 2 lines long above, very little produced below the tail, furnished with two parallel ridges above, each ending in a small spine, side by side or superposed, or sometimes the terminal scute is only simply pointed. Scales in 15 rows round the middle of body; ventrals twice as broad as the adjoining scales, 183 to 198; subcaudals 15 to 17 (in all the six specimens collected); anal large, bifid. Length 16–21 inches, with a girth up to 1⅝ inch. Back uniform blackish, very iridescent; belly and sides whitish, each of the three rows of scales on each side of the ventrals with a very regular oblong black blotch, forming three very regular parallel lines on each side; each ventral and subcaudal with a large parallelogrammoid black blotch.

Hab. Travancore Hills; in the Mutikuli Vayal, a valley in the mountains in South Travancore, elevation 4500 feet; also about Peermede and the neighbouring forest, in North Travancore, elevation about 4000 feet.

Platyplectrurus.

Platyplectrurus, Günther, Ann. & Mag. Nat. Hist., June 1868.

Head very flat; cleft of the mouth deep; snout broad, very obtusely rounded; eye distinct, rather large, surrounded by the supraorbital, postocular, frontal, and fourth labial; a long temporal shield between the fourth labial and the occipital; tail rather long, tapering, the posterior part somewhat compressed; the caudal scales quite smooth, or with

only very faint traces of keels on a few of the last; the terminal horny scute in the male broad, with a sharp horizontal edge, grooved or somewhat concave below, and compressed into a ridge on the upperside, which terminates in a single point; in the female very similar but smaller, ending in a single point, the horizontal ridge inconspicuous; the first pair of lower labials form a suture behind the median, followed by a pair of chin-shields; no median groove along the chin; teeth conspicuous, gradually longer behind, about 8 in the maxillary and 5 in the mandibular bones.

Hab. S. India.

Synopsis of Species.

Brick-red, with three longitudinal interrupted black lines..	*trilineatus.*
Uniform brownish, belly and sides dotted	*madurensis.*
Blackish, with a longitudinal yellow line down each side of the back	*bilineatus.*

Platyplectrurus trilineatus.

Platyplectrurus trilineatus, Gunther, *l. c.*
Plectrurus? trilineatus, Bedd. Madr. Journ. Med. Sciences, 1867, p. 14.

Snout very obtusely rounded; rostral pointed behind, very small, one third the size of a nasal; nasals forming a suture behind the rostral; supraorbital three times as large as the postocular; a long temporal shield always present; tail compressed towards the end, the scales all quite smooth, or a few of the terminal ones very inconspicuously 2–3-keeled; terminal scute in the males shovel-shaped, with a horizontal edge, concave below, and with a ridge along the upper surface which ends in a sharp point; in the females very small, equalling 1 to 2 scales, ending in a single point, but generally with an inconspicuous ridge. Scales in 15 rows round the middle of the body; ventrals twice as large as the adjoining scales, from 165 to 168 in the males, to 174 in the females; subcaudals 14 or 15 in males, 8 to 10 in females. Length about 15 inches, the females much stouter than the males, being $1\frac{3}{8}$ inch in girth, the males only $\frac{7}{8}$ inch. Body and belly of a bright brick-red colour, with 1 dorsal and 2 lateral black punctated lines, which extend from the neck to the end of the tail, the black dots each occupying a scale; the lines are sometimes here and there interrupted by 1 to 3 consecutive scales wanting the black marks.

Hab. Anamallay forests, above Ponachi, at an elevation of about 4000 feet. A rare snake; only six have been found, with ventrals and subcaudals as follows:—

Females	8	subcaudals and	178	ventrals.
	9	" "	171	"
	10	" "	171	"
	10	" "	174	"
Males	14	" "	167	"
	14	" "	168	"
	15	" "	165	"

Platyplectrurus madurensis.

Platyplectrurus madurensis, Bedd. Proc. Zool. Soc. March 16, 1877.

Snout very obtusely rounded; rostral very small, scarcely reaching the surface of the head; nasals very large; vertical six-sided, not much produced behind; supraorbital three times as large as the postocular (which latter is rarely confluent with it); a long temporal shield always present; tail not much compressed, the scales quite smooth, the terminal scute horny, in the male with a sharp horizontal ridge and compressed into a ridge on the upper surface, which ends in a single point, in the female very small, size of 1 to 2 scales only, and ending in a single point, with sometimes traces of the horizontal ridge. Scales round the middle of the body in 15 rows; ventrals not twice as large as the scales of the adjoining series, 149 to 159 in males to 170 to 176 in females; subcaudals 14 or 15 pairs in males, 9 to 11 pairs in females. Length of adults 12–14 inches, females up to $1\frac{1}{8}$ inch in girth, males about $\frac{7}{8}$ of an inch only. Above a nacreous purplish brown; ventrals and the two adjoining series of scales on each side white in the centre, but with a very complete ring round the margins of the same colour as the back.

Hab. Pulney mountains (Madura district), about Kodiekarnal, 6000 feet elevation, and a little above Shembaganoor, 5000 feet; also about Peermede, on the Travancore Hills, 4000 feet elevation.

Platyplectrurus bilineatus, n. sp.

Snout very obtusely rounded; rostral small, just reaching the surface of the head; nasals large; vertical six-sided; supraorbital as in *madurensis*; a long temporal shield always present; tail not much compressed, the scales quite smooth, the terminal scute somewhat dilated horizontally, ending in a small, single, upturned point. Scales round the body in 15 rows; ventrals twice as large as the adjoining scales, 168 to 172; subcaudals 13 or 14. Length 6–7 inches, girth $\frac{3}{8}$ of an inch. Body blackish, with a continuous longitudinal yellowish line down each side of the back, on the rows of scales on each side of the central dorsal series.

Hab. Madura Hills. The specimens are probably not adult.

III.—*On the* Bruchidæ *of Japan.* By D. Sharp.

THE specimens of this family brought home by Mr. G. Lewis are not so numerous as might have been anticipated, and it would appear that in Japan, as well as in Central America, these insects are rarely met with at large in any numbers, being in this respect dissimilar to our European species, many of which in the warmer parts of France and Spain are frequently met with in the greatest abundance. Altogether Mr. Lewis obtained thirteen species, three or four of which are probably merely introductions from abroad to the Japanese fauna; such is, I believe, the case with the two European species found in Japan, and with the American *B. pusillimus*; *B. dorsalis* was described from India by Schönherr, and *B. scutellaris* is now widely distributed in the world. The other species, to the number of eight, are at present peculiar to Japan; but as very little indeed is known about the oriental Bruchidæ, it is probable that some of them occur elsewhere. The most noteworthy feature of the Japanese Bruchidæ is the occurrence there of a remarkably distinct genus; there are only three other genera of Bruchidæ known—each of them has many species and a wide distribution, and it seems therefore scarcely possible that Japan should possess as peculiar to itself a genus of a very isolated character.

Bruchus dorsalis.

Bruchus dorsalis, Fahrs. Schönh. Gen. Curc. v. p. 98.

This species has been recorded as destroying seeds of *Gleditschia sinensis* brought to this country from Japan (*cf.* Proc. Ent. Soc. Lond. June 1873); it is apparently, however, not a common insect in Japan, as Mr. Lewis met with only two or three examples.

Bruchus pisi.

Bruchus pisi, Linn. Syst. Nat. 2, ii. p. 604.

Yokohama. One example.

Bruchus loti.

Bruchus loti, Gyll. Ins. Suec. iii. p. 13.

Of this common European species Mr. Lewis met with a single example at Kawachi. It is in a bad state of preservation, but appears to agree entirely with European specimens, except that it is of very large size.

Bruchus terrenus, n. sp.

Oblongo-ovalis, niger, griseo subvariegatus; antennarum basi pedibusque anterioribus et intermediis rufis; abdomine elongato, pygidio obliquo. Long. 2¾ millim.

Antennæ short; second, third and fourth joints small, 5–10 transverse. Eyes rather small, widely separated. Thorax conic-transverse, coarsely punctate, black, slightly variegated with grey. Elytra quite finely striate, black, extensively but rather indefinitely mottled with grey. Under surface grisescent. Femora unarmed; hind tibiæ digitate at extremity.

This is readily distinguished from the other species by the more elongate ventral rings and less horizontal pygidium. The front coxæ too are smaller and scarcely project beyond the extremity of the prosternum.

Yokohama, Nagasaki, Ichiuchi, and Yuyama. Five examples.

Bruchus urbanus, n. sp.

Oblongo-ovalis, niger, griseo-pubescens, pygidio abdominisque segmentis ultimis rufescentibus; antennarum basi fusco-rufa; pedibus anterioribus et intermediis rufis, femoribus basi tarsisque fuscis; supra variegatus, prothorace elytrisque nigris, illo basi, his sutura late fasciisque transversis griseis. Long. 3½ millim.

Var. Supra ubique griseo-pubescens, vix subfasciatus.

Antennæ short, rather stout; three or four penultimate joints transverse, the four basal joints dark above, red beneath, the rest black. Eyes moderately large, widely separated. Thorax transverse-conic, very coarsely punctate, black, largely grisescent at the base in the middle, less so on each side, and with a few minute grey flecks. Elytra with intense black pubescence, but broadly grey along the suture, and with three slender, irregular, grey, transverse fasciæ. Pygidium large, reddish grey, densely griseo-pubescent, submaculate on either side; the four apical ventral segments coloured like the pygidium, basal segment darker. Hind femora unarmed; hind tibia with two equal digits at the extremity of the lower face.

The variety, though appearing very different, has nothing, so far as I can see, to distinguish it from the type form, except the nearly uniform griseous colour of the upper surface, in which, however, the same markings as are present in the type can be detected, they being of a slightly different tint of grey from the ground-colour.

This is larger than *B. japonicus*, and is readily distinguished

from it by the different colour of the antennæ and hind legs, and the absence of the raised grey callosity in front of the scutellum.

Nagasaki. Two specimens of the typical form and one of the variety.

Bruchus ademptus, n. sp.

Minus elongatus, niger, griseo variegatus; pygidio abdominisque segmentis duobus ultimis rufis; antennis pedibusque anterioribus et intermediis flavis; femoribus posterioribus dente elongato armatis. Long. $2\frac{1}{2}$–$2\frac{3}{4}$ millim. (capite inflexo).

Antennæ short and rather stout, clear yellow, penultimate joints strongly transverse. Eyes rather prominent, widely separated. Thorax conic, coarsely and densely punctate, griseo-pubescent. Elytra rather finely striate, with elongate small marks of grey pubescence. Hind femora armed beneath with a rather long tooth on inner margin, and with a slight obtuse prominence on the outer margin; hind tibia with mucro at the apex.

The armature of the hind femora distinguishes this from all the other Japanese species except *B. scutellaris*; the two species are so dissimilar in colour that they cannot be mixed.

One example was found at Yuyama, May 10, 1881, and a second, in which the variegation of the upper surface is much less conspicuous, at Nagasaki.

Bruchus japonicus.

Mylabris (*Bruchus* ‡, Linn.) *japonica*, Harold, Deutsch. ent. Zeitschr. xxii. p. 87 (May 1878).
Bruchus fulvipes, Rœl. C. R. Ent. belg. xxii. p. lv (April 1879).

Nagasaki, Junsai (*Lewis*), Hagi (*Hiller*).

Bruchus comptus, n. sp.

Minutus, brevis, niger, albido-pruinosus; thorace ante scutellum densius albido-pubescente; antennis pedibusque flavis; femoribus muticis. Long. $1\frac{1}{2}$ millim.

Antennæ pale yellow, rather short, thicker externally; penultimate joints transverse. Eyes widely separated. Thorax conic, coarsely punctured, with a rather scanty white pubescence evenly distributed, except that it is concentrated so as to form a white mark, or rather two marks joined in front of the scutellum; this latter minute and obscure, not densely pubescent. Elytra pubescent, like the thorax; as also are the pygidium and under surface.

This is allied to *B. japonicus*, but is only half the size,

and is readily distinguished by the almost unicolorous surface and shorter antennæ.

Kobé, June 8, 1881; Hosokute, July 22, 1881. Three examples.

Bruchus pusillimus.

Bruchus pusillimus, Sharp, Biol. Cent.-Am. Col. v. p. 479.

Mr. Lewis brought three individuals of this species, which he noted as found in cargo and probably imported.

Bruchus lautus, n. sp.

Oblongo-ovalis, niger, æqualiter griseo-pubescens; antennarum basi pedibusque anterioribus testaceis, illis extrorsum pedibusque posterioribus fuscescentibus; prothorace conico; antennis serratis, maris valde elongatis, feminæ mediocribus. Long. 3 millim.

Eyes large, very prominent, very deeply emarginate, moderately distant in the female, more approximate in the male. Antennæ slender, feebly serrate internally; in the male rather longer than the insect, with the second joint very short, scarcely half as long as the third; in the female much shorter, with the second joint less abbreviated, but shorter than the third. Thorax conic, about as long as it is broad at the base, coarsely punctate. Pubescence evenly distributed, not spotted. Elytra rather deeply striate. Pygidium closely covered with grey pubescence. Hind femur simple; tibia with short stout apical mucro.

Found sparingly; usually one or two examples in a locality. Otsu, Fukiu, Fukushima, Junsai, and Hakodate, by sweeping in August.

Bruchus scutellaris.

Bruchus scutellaris, Fab. Syst. El. ii. p. 399.
Mylabris chinensis, Har. Deutsch. ent. Zeitschr. xxii. p. 87.

Harold (*loc. cit.*) considers this insect to be the *Bruchus* (*Curculio*) *chinensis*, Linn.; but I am not able to adopt this view, the evidence appearing to me to be against its probability. He also treats the Chinese *B. adustus*, Motsch., as a synonym of this species; but this also appears to me improbable; indeed the measurements given by Motschoulsky quite contradict this conjecture.

Nagasaki (*Lewis*), Hagi (*Hiller*), Tokio (*Hoffman*, teste *Harold*).

Spermophagus complectus, n. sp.

Rotundato-ovalis, niger, fusco-pubescens, subvariegatus; elytris

striatis; striis fortiter punctatis. Long. 3½ millim. (capite inflexo).

Very similar to the well-known European *S. cardui*, but rather larger than the largest examples thereof, and readily distinguished by the more abundant pubescence, which is of sordid very dark grey colour, and a little variegate, more especially on the pygidium, and by the much more conspicuous punctuation of the elytral striæ; the front coxæ are more distinctly separated, the middle legs more widely distant, and the mesosternum less prominent and less exposed at its apex.

One example; found on the sand-hills at Hakodate.

PYGOBRUCHUS (nov. gen.).

Pygidium e segmentis tribus compositum. Coxæ anteriores elongatæ, contiguæ. Femora posteriora gracilia, tibiæ absque calcaribus.

This insect has the appearance of a convex *Bruchus*, but is very different on account of the peculiar structure of the pygidium; this is elongate, and about one half of its length is occupied by the last dorsal segment; the penultimate segment exposed is also large, but the antepenultimate is much shorter.

Pygobruchus scutellaris, n. sp.

Niger, griseo-pruinosus; prothorace conico-transverso, fortiter punctato; scutello elongato, apice bidentato; antennis (maris) flabellatis. Long. 3¾ millim.

Antennæ elongate, entirely black; second joint minute, third elongate, giving off from the middle a rather long process, the following joints armed with still longer processes. Head short; eyes rather large, widely separated. Thorax much narrowed in front, the sides very little rounded at the front angles; the whole surface coarsely punctate and evenly covered with a somewhat scanty griseous pubescence. Scutellum elongate, with prominent extremity, which is deeply notched. Elytra rather deeply striate; the internal striæ crenate, the outer punctate rather than crenate, and becoming behind effaced so as to form there rows of punctures rather than striæ; interstices with some indistinct punctures, much concealed by the pubescence. Pygidium also with coarse punctures concealed by the pubescence. Ventral rings short.

Kobé, June 8, 1881; a single male example.

IV.—*A new Genus of Heteromerous Coleoptera allied to* Notoxus. By CHARLES O. WATERHOUSE.

THE interesting form which I here describe has been in the British Museum for some time, and being a very conspicuous insect I thought it had in all probability been named. As that, however, does not appear to be the case, I propose to call it *Hypaspistes*.

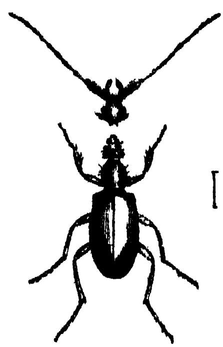
HYPASPISTES, n. gen.

General characters of *Notoxus*, but differing as follows:—Antennæ as long as the whole insect, the second joint very short, the following joints very long and slender. Apical joint of the maxillary palpi longer and more distinctly cultriform. Anterior femora with the lower edge compressed and with an acute tooth at the base. Tarsi long and slender, the penultimate joint very short, narrower than in *Notoxus*. Scutellum very small.

Hypaspistes armatus, n. sp.

Testaceus, nitidus, lævis, parce pallide pubescens; thoracis processu supra granulato, utrinque tridentato.

Long. 5 millim.



Head smooth and shining, the underside with numerous round black granules. Basal joint of the antennæ beset with long pale pubescence. Thorax smooth and very convex, suddenly declivous posteriorly. The thoracic process as long as the body of the thorax, with numerous nearly black shining granules, those at the base transverse; apex with the margin incrassate; each side with three strong teeth, which are nearly black at the apex. Elytra very convex, shining, sparsely pubescent. Legs pale testaceous; anterior tibiæ a little enlarged in the middle, pubescent on the inner side.

Hab. Ceylon (*Dr. Thwaites*).

I.—*Descriptions of Sponges from the Neighbourhood of Port Phillip Heads, South Australia, continued.* By H. J. Carter, F.R.S. &c.

[Continued from vol. xvi. p. 368.]

Pursuing the plan which has been adopted in revising the other orders of the Spongida, I will premise the following tabular view of the original arrangement of my order Holorhaphidota (*op. et loc. cit.*) thus:—

Order VI. HOLORHAPHIDOTA.

Families	Groups.
	1. Amorphosa.
	2. Isodictyosa.
	3 Thalyosa.
	4. Crassa.
1. *Renierida*	5. Fibulifera.
	6. Halichondrina.
	7. Hyndmanina.
	8. Esperina.
	9. Hymedesmina.
	10. Cavernosa.
2. *Suberitida*	11. Compacta.
	12. Laxa.
	13. Donatina.
	14. Geodina.
3. *Pachytragida* .	15. Stellettina.
	16. Tethyina.
4. *Pachastrellida*	17. Pachastrellina.
	18. Lithistina.
5. *Potamospongida* .	19. Spongillina.

The diagnosis for this order—viz. "Possessing a skeleton whose fibre is almost entirely composed of proper spicules bound together by a minimum of sarcode; form of spicule variable,"—was proposed for those sponges which, from the absence of that amount of keratine or horny material in their fibre that renders the orders IV. and V. (although they too possess "proper spicules," that is, spicules formed by the sponge itself) more or less resilient or sponge-like, are more or less tender, fragile, and easily broken by pressure, varying in consistence from a crumb-of-bread character in the Amorphosa to the almost stony hardness of the Lithistina; so that in the more limited acceptation of the word "sponge" the latter would not be considered sponges

at all. Hence we have to deal here *not* with the "limited acceptation" of the term "sponge," but with the products of the sponge-animal in its most extended sense, although at one time, as in the Carnosa, this may be almost undistinguishable from glue when both are dried, at another, as in the sponge of commerce (which is the most familiar form), a resilient mass of horny thread-like tissue (that is the skeletal structure of the sponge from which the soft parts have been extracted by putrefaction and edulcoration), and in a third, as in the Lithistina, so compact and stone-like that it yields to nothing but a knife or hammer.

So much for the order then; let us now turn our attention to the families respectively.

Fam. 1. **Renierida.**

Char. Spicules more or less arranged in a fibrous form; structure yielding to pressure, like crumb of bread.

To this family my experience of the last ten years, viz. since my "Notes Introductory to the Study and Classification of the Spongida" were published in 1875 ('Annals,' ser. 4, vol. xvi. p. 177 *et seq.*), has not enabled me to add much, and I have very little to alter. Many new species I have described; but they must be sought for in the pages of this periodical, which I have not time now to specify.

PHLŒODICTYONINA (new group).

I would, however, observe that, having found several species more or less presenting the characters of *Oceanaria*, Norman = *Desmacidon Jeffreysii*, Bk., I have put them together under the above name, and would place this new group immediately after no. 4, viz. "Crassa." More I need not state of it here, as the whole will be found in the 'Annals' for 1882 (vol. x. p. 117 *et seq.*), and an additional species in those of 1883 (vol. xii. p. 326 *et seq.*).

To the mode of circulation in the Phlœodictyons, in which no vents have been discovered, I shall have to return hereafter when describing some of Mr. Wilson's specimens of *Polymastia* from Port Phillip Heads, in which, by analogy, the position of these vents seems to be indicated.

I have also added a few remarks as well as descriptions of new species to group no. 8, viz. "Esperina" ('Annals,' 1882, vol. ix. pp. 288–301; *ib.* 1880, vol. vi. p. 49, pl. v. fig. 20; *ib.* 1874, among the "Deep-sea Sponges dredged by H.M.S.

'Porcupine,'" vol. xiv. p. 207; and *ib.* 1876, vol. xviii. p. 226, &c.). But I am not certain that I have enumerated all the places in the 'Annals' where I have described species of this or any other group of sponges, so "once for all" can only state that it will be necessary to search the pages of this periodical generally for this purpose, to which it might be added that on most occasions the references *alone* to my contributions on the classification of the Spongida will be given, which it will be easier for me to do than for the reader to find them out for himself, while it will enable me to save that time of embodying them *in extenso* which a few years ago would have been of less consequence to me.

Fam. 2. **Suberitida.**

"*Char.* Tissue cork-like; spicules matted, felt-like, cancellous, and crushable, or radiated, compact, and hard; spicule chiefly pin-like, the sharp ends projecting from the surface, like velvet."

As I have to add many new groups to this family, it will be necessary to meet this by a slight alteration in the diagnosis, which may now stand thus:—

"*Char.* Tissue loose, cork-like, or solid and tough. Skeletal spicules chiefly pin-like, varying in shape from globular-headed to simple acuate, with more or less fusiform shaft; arranged in a confused, felt-like, reticulated skeletal mass, or in bundles radiating from the centre."

Hence it will be observed that all mention of "cancellous and crushable" structure has been omitted, since this is found to obtain only in dried specimens, where the sarcode has shrunk away, and nothing is left but the more durable skeletal fibro-reticulation, a fact that I did not well realize until I began to examine Mr. Wilson's fresh or wet specimens, which shows their value in this respect and the disadvantage of framing a diagnosis *only* on specimens that are dry.

Whether or not it would be desirable in description to give the state of a sponge in both conditions I must leave future observation to determine. I think it would where this can be done, or when both conditions are present; but where, as in many instances, the specimen can only become known by its presence on the beach, washed, water-worn, and dry, having originally come from the vault of some submarine cavern, where, by accident or otherwise, it has been torn from its place of attachment, it would be desirable to add, as Dr. Bowerbank has done, "examined in the dried state." And this must be the case in many instances, unless they are

gathered by human hands, for the dredge cannot reach them on the undersides of rocks. At the same time dried specimens also may differ considerably, inasmuch as the washed-out beach-worn specimen differs greatly from those which have been carefully soaked in fresh water and dried for preservation immediately after they have been taken, alive and growing, from their place of attachment, as Mr. Wilson's dried specimens also evidence; next to the wet state, this is the best and most convenient condition for museum-collections. But still, for perfect description the wet state is also necessary.

Thus alterations in diagnosis and classification may have to be continued so long as knowledge of the subject increases.

Having again, as far as my material would allow, studied the groups 10, 11, and 12, viz. the Cavernosa, Compacta, and Laxa, after the manner detailed in the 'Annals' of 1882 (vol. ix. pp. 347-356) chiefly from *dried* specimens (as in my original classification), it seemed to me desirable to add another group to these sponges under the name of "Subcompacta" (*ib.* p. 358), and I must refer the reader to this paper for what I then stated on the subject; but since I have had the advantage of examining wet or undried specimens, the principle of this classification, viz. the degree of consistence on which I then based my divisions, as may be inferred from the names of the groups, has undergone much modification. But, as I am not prepared to alter the arrangement *in extenso* now, I would merely observe that it also seems to me desirable that these four divisions should be considered parts of one group only, for which I would propose the name of "Suberitina;" in support of which it might be stated that, although the pin-like skeletal (with or without a flesh-spicule) for the most part prevails in these sponges, and there are some to which I have alluded at the conclusion of the paper last mentioned, in which the skeletal spicule is *not* pin-like, that still appear to me to find their most appropriate place in this group, yet, however this may be, the pin-like skeletal with or without a flesh-spicule of a spinispirular form appears to be the prevailing character of the spiculation in the "Suberitina," and as the latter gradually diminishes in size and number from the genus *Spirastrella*, Sdt., to those Suberitina in which there is no longer any trace of it, I would place the whole in this group.

In the genus *Latrunculia* of Bocage, to which I have also alluded in the paper last mentioned (p. 354), the spinispirular

flesh-spicule is replaced by the sceptrella (see my descriptions and illustrations of these two forms of the flesh-spicule in the 'Annals' of 1879, vol. iii. p. 354 &c., pl. xxix. figs. 11 &c.), and the skeletal spicule is no longer pin-like, but acuate or acerate, as may be seen by the species that have been described, while in *Latrunculia corticata*, Carter (*ib.* p. 298, pl. xxvii. fig. 1 &c.), the form of the flesh-spicule *varies* from *sceptrellar to spinispirular* in the *same* specimen. So that altogether it appears to me desirable that these sponges should come in immediately after the group Suberitina under the name "Latrunculina." Schmidt has placed them in his "Desmacidinæ" (Grundz. Spongf. Atlant. Gebietes, p. 80), because his species, viz. *Sceptrella regalis*, possesses an anchorate flesh-spicule in addition to the sceptrella; but if the presence of an anchorate or any other form of flesh-spicule be allowed to determine the position of a sponge in classification, the principle, according to my experience, will be found impracticable.

On group 13, viz. the Donatina, I have also published observations in the 'Annals' of 1882 (together with a new species or growth), vol. ix. pp. 356–362, pl. xii. fig. 22, to which I must refer the reader in addition to what is stated in my original classification (p. 182).

But between Donatina and Latrunculina I would introduce the three other groups mentioned in the same paper and under the same heading, viz. "Donatina" (p. 356 &c.), *i. e.* Polymastina, Xenospongina, and Placospongina, transferring the "intensely compact" species to which I have therein alluded to a *separate* group, as I find that, having *no* mamilliform processes, the latter cannot properly be included in the group Polymastina, however much in other respects, that is in the spiculation, they may resemble each other. Thus, having established a genus of these intensely compact sponges under the name of "*Trachya*" in 1870 ('Annals,' vol. vi. p. 178), and having in 1876 ('Deep-sea Sponges dredged by H.M.S. 'Porcupine,'' vol. xviii. pp. 392 and 393) proposed to place them in the group Polymastina as a subdivision, adding at the same time a brief description of another species equally typical of this kind of sponges under the name of *Trachya durissima* ('Annals,' 1882, p. 357), I must refer the reader to the last-mentioned as well as to the genus *Trachya* (*l. c.*) for the characters of the species which I would here group together under the name of "Trachyina."

I had forgotten to allude to that remarkable sponge of which Mr. G. Clifton found branched specimens "over 6 feet in length, and when alive of a bright red colour," on the west coast of Australia, for which the late Dr. J. E. Gray proposed the generic name "*Axos*;" and which, with its allies, I should be inclined to place immediately after Donatina, under the name of "*Axosina*" ('Annals,' 1879, vol. iii. p. 284 &c. pl. xv.); substituting the latter term for "Axona," proposed in the 'Annals' for 1881 (p. 381); where, I would also observe *en passant*, the species respectively described thereafter under the names of *Axos anchorata* and *A. flabellata* should have their generic appellations respectively changed to "*Phorbas*," D. & M., and their position relegated to the group Halichondrina still among the Holorhaphidota, for the reasons mentioned in my paper on the West-Indian sponges ('Annals,' 1882, vol. ix. p. 288).

The group "Axosina" might therefore be inserted immediately after Donatina, as the structural alliances to which I have above alluded, and which will be found at p. 289 ('Annals,' 1879, vol. iii.), seem to indicate.

Lastly, I find a new structure among Mr. Wilson's sponges, which assumes a more or less globular form; but this is *without fibre*, and the sarcode, which is chondroid, as much charged with sand grains as it is with the spicules of the species, which are cylindrical and obtusely pointed, accompanied by a smaller one in the form of an acuate; so that it is questionable whether it should come under the second family of the order Carnosa, viz. the Gumminida, or under the Suberitida in the order Holorhaphidota, as hinted of the group Donatina in my paper on the then known species of Carnosa ('Annals,' 1881, vol. viii. p. 255, &c.). At all events, for the present, I shall insert it as a new group, with the name of "Chondropsina," immediately after "Placospongina" at the end of the family Suberitida, while the type-specimen under the name of *Chrondopsis arenifera*, will be more particularly described hereafter among Mr. Wilson's specimens. In the dried state the abundance of sand and its want of fibre, that is, its diffused arrangement, makes this specimen look like one of the genus *Sarcocornea* ('Annals,' 1885, vol. xv. p. 214 &c.). But the spiculation being all of one kind and the spicules *perfect*, is opposed to this.

Eccœlonida, or *Excavating Sponges* (new family, No. 3, p. 49).

Char. Sponges living in small chambers stoloniferously connected, which have been excavated by themselves or other

animals in either organic or inorganic calcareous material; communicating with the exterior through the stoloniferous canals.

Differing from all other sponges in their habitat is that family for which I have proposed the above name; but as they equally differ from each other in their spiculation it also becomes necessary to group them accordingly. Hence, at the end of my illustrated description of *Alectona Millari* (Journ. Roy. Micros. Soc. 1879, vol. ii. p. 493, pl. xvii.), they have been divided into three genera with the suggestion of a fourth for the genus "*Samus*," which, typically considered, would respectively lead to the formation of the following groups, viz. "Clionina," "Thoosaina," "Alectonina," and "Samusina." To the paper in the journal mentioned, as well as the 'Annals' of 1880 (vol. vi. p. 56 &c., pl. v.) and those of 1879 (vol. iii. p. 350 &c. pl. xxix. figs. 1–7), I must refer the reader for all the information that I have hitherto been able to contribute on this subject.

Fam. 3. **Pachytragida.**

"*Char.* More or less corticate with cancellous more or less radiated structure internally; well differentiated."

On this family I published a paper in the 'Annals' of 1883 (vol. ii. p. 344 &c.), therefore need not repeat any more of it here except that I found it necessary to intercalate between Stellettina and Tethyina a fourth group under the name of "Thenеanina," whose history, characters, and classification will be found in the same paper (pp. 354 to 362 inclusively).

Also to this family I would still add another group under the name of "Stellettinopsina," immediately after Stellettina, for species of the genus *Stellettinopsis*, which promise to be so numerous as to claim this distinction. They are principally characterized by possessing only *one* form of skeletal spicule, and this a large, smooth acerate, like the body-spicule of *Stelletta*, together with one or two forms of the stellate spicule, as noticed in the illustrated description of my type-species *Stellettinopsis simplex*, from which the rest of the characters of this group may be extracted ('Annals,' 1879, vol. iii. p. 349, pl. xxviii. figs. 16–18).

New species of all the groups in this family have also been described here and there in the 'Annals,' to which respectively I must again refer the reader for further information on *this* subject.

Fam. 4. **Pachastrellida.**

"*Char.* Without cortex; densely spiculiferous, even to stony hardness; structure confused; no fibre."

When I use the word "confused" it must be understood that the structure is so only apparently, for there is nothing confused in Nature, wherein all is harmony, and everything has its place.

With reference to the two groups of this family, viz. 17 and 18, respectively named Pachastrellina and Lithistina, I have nothing to add beyond what is stated in my original classification (*l. c.* pp. 185 to 187), the whole of which "classification was chiefly compiled to facilitate a description and location of the sponges dredged by H.M.S. 'Porcupine' ('Annals,' 1876, vol. xviii. p. 226), where, at pp. 406 to 410, some new species of *Pachastrella* will be found, together with that from Japan, described in the 'Annals' of 1885 (vol. xv. p. 403). Of new species of the group Lithistina I had, with the exception of what is stated in the 'Annals' of 1873, vol. xii. pp. 437–444, and 1876, vol. xviii. pp. 460–468, no communication to make until 1880, when my report on the specimens from the Gulf of Manaar &c. was published ('Annals,' vols. v., vi., and vii., pp. 437, 35, and 361), wherein at p. 142, pls. vii. and viii., and p. 372, pl. xviii. vols. vi. and vii., several will be found described and illustrated, together with the mode of development of the skeletal spicule which these young and perfect specimens enabled me to follow satisfactorily, so that in *Discodermia* it was easy to see that the most complex form of the tetractinellid, skeletal spicule originated in the simple nail-like disk of the surface, which, *when not more than* 1-300*th inch in diameter, presents the quadrifid canal* that characterizes the fully developed tetractinellid form. Lastly, this was again observed in the large and fresh specimen of *Racodiscula asteroides* from Japan, which I described and illustrated in the 'Annals' of 1885 (vol. xv. p. 400, pl. xiv. fig. 11).

Fam. 5. **Potamospongida.**

"*Char.* Fragile sponges bearing seed-like bodies or statoblasts and inhabiting freshwater."

For my division of the "then known species" of the sponges to be included in this family and their history generally, see my paper in the 'Annals' of 1881 (vol. vii. pp. 77 to 107, pls. v. and vi.). It has been contended that my "characters" of this family are incomplete, seeing that no seed-like bodies (gemmules or statoblasts) have yet been found in *Uruguaya corallioides*, Bk., or in *Lubomirskia baicalensis*, Dybowski;

but then no other mode of propagation in these sponges has been described; and therefore, however probable it is that this may be the case, it as yet only rests on inference; while Lieberkühn long ago made it plain that *Spongilla* might be propagated sexually (that is, by ova and spermatozoids), or by the so-called seed-like bodies respectively.

The above revision of my order Holorhaphidota may appear very short, but if the papers to which I have referred be read it will be found to be very long, for since my original classification was published in 1875 I have ever and anon been publishing the result of my considerations of different parts of it, and especially that of the Holorhaphidota, whereby several additions have been made to the latter, which, as before stated, it is much easier for me to indicate shortly with a few remarks than to embody *in extenso*. Hence, this revision will only be found interesting to those who wish to know what I have written on the subject, or might hereafter do what I should if time permitted do myself, that is publish a "handy volume" or Manual of the Spongida, including a synopsis of *all* the species that have been described, accompanied by the author's name, the date of description, and the place where described, with synonyms in like manner if there should be any. Such a compilation is now urgently required for the advancement of this branch of Natural History, which, so long as our knowledge of the subject remains inconveniently scattered through a number of books, *must continue* to lead more or less to petty classifications and the proposing of new and probably inappropriate names which may entail the inconvenience of reference and perhaps contradiction, because they have been based on a limited knowledge of the subject derived from access only to a few specimens. Species first and then classification.

All therefore that I can now do more in this respect, previously to describing Mr. J. Bracebridge Wilson's specimens which belong to the order Holorhaphidota, is to repeat the tabular view given at the commencement of this article with the additions subsequently proposed in "italics," together with the necessary changes in the numbering of the groups &c., so that the reader may see at a glance how the Table will now stand:—

Order VI. HOLORHAPHIDOTA.

Families.	Groups.	
	1. Amorphosa.	
	2. Isodictyosa.	
	3. Thalyosa.	
	4. Crassa.	
	5. *Phlœodictyonina.*	
1. *Renierida*	6. Fibulifera.	
	7. Halichondrina.	
	8. Hyndmanina.	
	9. Esperina.	*Subgroups.*
	10. Hymedesmina.	Cavernosa.
	11. *Suberitina*, for	Compacta.
	12. *Latrunculina.*	Subcompacta.
	13. *Polymastina.*	Laxa.
	14. *Trachyina.*	
2. *Suberitida*	15. Donatina.	
	16. *Axosina.*	
	17. *Xenospongina.*	
	18. *Placospongina.*	
	19. *Chondropsina* (provisional).	
	20. *Clionina.*	
3. *Ecœlonida* (new family) ..	21. *Thoosaina.*	
	22. *Alectonina.*	
	23. *Samusina.*	
	24. Geodina.	
	25. Stellettina.	
4. *Pachytragida*	26. *Stellettinopsina.*	
	27. *Theneanina.*	
	28. Tethyina.	
5. *Pachastrellida*	29. Pachastrellina.	
	30. Lithistina.	
	31. *Spongillina.*	
6. *Potamospongida*	32. *Meyenina.*	
	33. *Tubellina.*	
	34. *Parmulina.*	

Having already at p. 351 *antea*, to avoid repetition individually, premised the circumstances under which I should describe the sponges of the order Echinonemata in Mr. Wilson's collection generally, I have only to state here that the same plan will be followed in describing those of the order Holorhaphidota.

Fam. 1. **Renierida.**

Group 1. Amorphosa.

1. *Amorphina anonyma.*

Massive, thick, compressed, lobed, sessile; truncated (? cut off by the dredge from the place of attachment) below. Consistence soft, loose. Colour not given, yellowish brown now. Surface smooth, covering a rough uneven structure below. Vents numerous, confined to the upper part. Spicules

of one form only, viz. acerate, varying under 75 by 2½-6000ths in. Structure loose, traversed plentifully by large excretory canals which terminate in the vents mentioned. Size of largest specimen, 3 inches high by 9 × 3 horizontally. Depth 6 to 19 fath.

2. *Amorphina nigrocutis.*

Massive, flattish, sessile, irregularly lobed above, truncated below. Consistence hard, elastic. Colour when fresh, "nearly black," dark slate now. Surface very smooth, covered with a minutely reticulated spiculo-fibrous dermis. Pores in the interstices of the reticulation. Vents large, at the ends of the mamilliform or prominent processes of the upper part. Spicules of one form only, viz. acerate, but of two sizes, following their situation, viz.:—1, chiefly confined to the body, 85 by 1½-6000th in.; 2, chiefly confined to the dermal, spiculo-fibrous reticulation, 25 to 30-6000ths long. Structure commencing from without inwards with a tough dermal coat about 1-48th in in thickness, contrasting strongly in its dark colour with the lighter substance of the interior, which is compact and traversed by the excretory canals that end in the vents mentioned. Size 1½ in. high by 4 × 1½ horizontally.

Depth 7 fath.

3. *Amorphina cancellosa.* (Dry specimen.)

Massive, sessile, erect, lobed, somewhat compressed, contracted towards the base. Consistence light, fragile. Colour whitish grey now. Surface cellular, reticulated in relief; interstices large, tympanized by sarcode charged with the spicules of the species. Vents very numerous, plentifully distributed over the surface generally, especially over the upper part. Spicule of one form only, viz. acerate, of different sizes, about 75 by 1½-6000th in. Structure light, open and cancellous throughout, almost flimsy from the great number of large excretory canals with which the loose structure is traversed, ending at the vents mentioned. Size of specimen, which is very large (even in its dry state), 12 in. high by 12 × 4½ horizontally. Neither depth nor colour given.

Group 3. THALYOSA.

4. *Thalysias massalis.*

Massive, sessile, elongated elliptically, truncate below. Consistence soft. Colour, when fresh, "buff below, dark maroon-red above," now light brown. Surface smooth, con-

sisting of a spiculo-fibrous, reticulated, dermal structure. Vents on monticular elevations irregularly projected here and there, chiefly over the upper part. Spicules of one form only, viz acerate, 37 by 1½-6000th in. Structure internally compact, much permeated by excretory canals. Size 2½ in. high by 3 × 5¾ horizontally.

Depth 20 faths.

Obs. I have placed this specimen in the group Thalyosa because the structure is more compact than that of the foregoing species; but really, at present, unless there is some peculiarity in form to distinguish the species beyond what I have mentioned in my Classification of the Amorphina, Isodictyosa, Thalyosa, and Crassa (*l. c.* p. 177), the presence of the acerate spicule alone in a massive amorphous structure for this purpose, must, for the most part, in a single specimen, be most unsatisfactory.

Group 6. FIBULIFERA.

5. *Fibulia carnosa* (provisional).

Fleshy, digitate, digitations branched; or digito-palmate; or long cylindrically caulescent once or twice branched, terminating in spatuliform bulbous ends; the digitations of the other forms terminating in contorted or crooked pointed ends, like deformed wasted-away fingers. Consistence solid, fleshy. Colour, when fresh, chiefly "black-red," now light brown. Surface smooth, almost slippery. Vents small, respectively projected on a papillary eminence, scattered generally over the surface where the branches are expanded, or in two lines opposite each other, where they are cylindrically digitate, that is Chalina-like. Spicules of two forms, viz.:—1, skeletal, smooth, acerate, 60 by 1¾-6000th in., more or less; 2, flesh-spicule, a minute simple C- and S-shaped bihamate (fibula) about 2-6000ths in. long; the former confined to the fibre and the latter dispersed in the sarcode. Structure compact and fleshy when wet, exceedingly hard and glue-like when dry, contrasting then, in its brown colour internally, with the white spiculo-fibre. Length of largest digitate specimen about 8 in. high by 4 × 1 horizontally; that of the long caulescent forms 12 in.; stem cylindrical, ½ in. in diameter; bulbous ends about 3 in. long and 1 in. broad.

Depth 5 to 18 faths.

Obs. This is a very remarkable sponge, partly on account of the forms which it assumes, and partly on account of its heavy, solid, fleshy consistence. I have placed it *provisionally* in the group Fibulifera under the above name, chiefly on

account of its spiculation. It seems to be very plentiful on the south coast of Australia, as there are several specimens of it in Mr. Wilson's collections, both wet and dry.

Group 7. HALICHONDRINA.

6. *Halichondria birotulata*, T. H. Higgin ('Annals,' 1877, vol. xix. p. 296, pl. xiv. figs. 11 and 12).

Obs. This sponge, which is characterized by its dark madder-red colour when dry, is also stated by Mr. Wilson to be "chocolate-black" when fresh, so that it does not lose its colour by keeping, either wet or dry. The birotulate spicule, after which it has been designated, is also peculiar in form, and so small that it is apt to pass unnoticed in the microscopic specimen when wet, but comes out well in a fragment that has been mounted in balsam. On the Australian coast it appears to be very common, occurring in the late Dr. Bowerbank's collection from thence, now in the British Museum, in large staghorn-like branched specimens.

7. *Halichondria isodictyalis*, Carter ('Annals,' 1882, vol. ix. p. 285, pl. xi. fig. 2).

Obs. The specimens of this sponge in Mr. Wilson's collection are massive and lobed, with large vents scattered over their surface, stated, when fresh, to have been "slate-brown" in colour. The principal difference between their spiculation and that of *Halichondria incrustans* (of which *H. isodictyalis* hardly amounts to more than a variety), is the spine*less* condition of the acuate. It appears to be almost world-wide in distribution.

8. *Tedania digitata*, Gray (Proc. Zool. Soc. 1867, May, p. 520).

Obs. Reniera digitata was Schmidt's earliest name for this species (Spong. Adriat. Meeres, 1862, p. 75, t. vii. fig. 11), which he afterwards changed to "*Tedania*, Gray" (Spongf. Atlantisch. Gebietes, 1870, p. 43).

There are several specimens of *Tedania digitata* in Mr. Wilson's collections whose form is massive and lobate, said, when fresh, to have been "orange" in colour. All are characterized by the same spiculation, viz.:—1, a smooth, stout, skeletal acuate; 2, sub-skeletal, fusiform acerate, inflated and scantily spined at each end, the "tibiella," first so named and described in the 'Annals' (1881, vol. vii. p. 369, pl. xviii. figs. 9, *b*); and 3, a very fine, pointed acerate, microspined all over.

The "tibiella" in Schmidt's *type*-specimens in the British Museum is not spined at the ends, nor is it in his descriptions and illustrations; but the "fine, pointed acerate" *is* microspined in them, although *not* described nor illustrated by him as such. But according to my observations generally, the spination of the ends of the "tibiella" is not constant, therefore of no specific value; while the microspination of the "fine acerate" can be seen only where it is strongly developed, and therefore, when otherwise is very likely to pass unnoticed.

9. *Tedania digitata*, var. *verrucosa*.

The same, but with the surface more generally convex and less lobate; the surface scattered over with small wart-like processes, and the colour, when fresh, stated to be "dull orange" and "venetian red" in the two specimens respectively. Besides being on a level with the surface, each little wart-like process terminates in a single vent, so that the structure is not like that described by Schmidt in his *Tedania suctoria* (Atlantisch. Spongf. *l. c.*).

10. *Forcepia colonensis*, Carter ('Annals,' 1885, vol. xv. p. 110, pl. iv. fig. 2).

[To be continued.]

VI.—*On the Occurrence of Sowerby's Whale* (Mesoplodon bidens) *on the Yorkshire Coast*. By THOMAS SOUTHWELL, F.Z.S., and WILLIAM EAGLE CLARKE, F.L.S.

On the 11th September last Prof. Turner communicated to the British Association, then assembled at Aberdeen, a paper on the anatomy of Sowerby's Whale, *Mesoplodon bidens*, Sowerby (=*M. Sowerbiensis*, Blainville), the material for which was mainly derived from the dissection of an individual obtained on the 25th of the preceding month of May, in Voxter Voe, on the north-east portion of the main island of Shetland, which island had already become noted as having yielded a previous specimen of this species as well as two other Ziphioids. Seeing the interest which attaches to this rare Cetacean we have great pleasure in being able to record the occurrence of yet another individual of the same species, the first, we believe, which has been met with on the English coast; but we regret to add that, owing to the ignorance of its captors as to the value of their prize, the carcase was cast adrift before the occurrence came to our knowledge, and was thus irretrievably lost to science. This is the more to be

regretted from the fact that (mainly through the excellent use which Prof. Turner has made of recent opportunities), at present, more is known with regard to the skeleton and anatomy of the soft parts of Sowerby's Whale than of its external appearance, added to which there are still several points in the anatomy of this species which it would be desirable to solve.

On the 11th September last, on the same day on which Prof. Turner made the communication to the British Association before referred to, a Cetacean was left stranded in shallow water just inside Spurn Head, at a spot known as the Chalk Bank; as the tide receded the animal made great efforts to get off into deep water, and lashed up the sand with its tail till a large depression was formed in which it lay. Observing the commotion two men rowed up from a sloop which was riding at anchor in the entrance to the Humber near to the spot, and despatched it with their oars. The animal was seen alive by several persons, amongst them by Miss Rose Smith, daughter of the chief light-keeper at the Spurn, and Mr. T. Winson, the coxswain of the lifeboat 'Spurn,' to whom jointly we are indebted for the little information we have been able to glean; for, under the impression that it was a common Bottle-nose Whale (*Hyperoodon rostratus?*), a man named Hopper "chopped it up" to obtain the oil, and the remains, with the exception of the tail, were set afloat and drifted out to sea beyond possibility of recovery. From a sketch kindly sent us by Miss Rose Smith and some interesting particulars supplied by Mr. Winson, there is not the slightest doubt that the animal was Sowerby's Whale, probably a full-grown male.

As no full description of the external appearance of this species has ever been given, we add the following particulars from the scanty materials we have been able to glean. The total length was 15 feet 9 inches, measured along curve; the greatest girth, which was about midway between the two extremities, was 8 feet; from that point it gradually tapered to about 15 or 18 inches at the insertion of the tail, which was nearly 3 feet across, its posterior border being entire and slightly convex in the centre. The girth just behind the head was between 6 and 7 feet. These measurements, with the exception of the first, are only approximative.

The head is said to have been highest at the blowhole, the beak tapering and 15 inches in length; the lower jaw projected beyond the upper, and was armed with two teeth, a little over 1 inch in length, and situated about midway between the end of the jaw and the opening of the mouth.

The skin is described as very smooth and polished; very dark slate colour or nearly black on the top of the head and along the back, the sides a lighter shade of slate colour, and the under parts much lighter still, but not quite white; the end of the beak and lower jaw rather lighter in colour than the upper portion of the head. Winson significantly speaks of the teeth as "tusks," and states that the animal uttered no sound. Upon inquiry Winson also states that he noticed a number of irregular marks on the sides and belly about 2 feet in length and a quarter of an inch wide; they were lighter in colour than the outer skin of the parts on which they appeared, and had "something the appearance of narrow strips of the skin having been removed;" to this cause he at the time attributed them, not knowing that they were "natural marks."

As before observed, the individuals of this species have hitherto always been so mutilated before they were seen by any person competent to give a full and accurate description of their external characters, that such a description is still a desideratum; but Prof. Turner, from such fragmentary accounts as have been given by different naturalists and from the specimen he was then describing, has compiled the following summary, which we venture to quote entire from his paper sent to the Royal Society of Edinburgh on January 30, 1882 *:—

"Length in adult 14 to 16 feet. Beak long and slender. Head swelling out considerably behind the beak. Body elongated. Back dark bluish grey or slate-coloured, sides lighter, belly whitish. Grey or whitish streaks and spots scattered irregularly on the sides. Dorsal fin nearer the tail than the head, falcate posteriorly. A dorsal keel in front of the tail. No median notch between lobes of the tail. Flipper small; both its anterior and posterior borders convex. Blow-hole semilunar, concave forward, not quite symmetrical. Mouth-slit straight in front, but concavo-convex further back. A pair of furrows converging in front on the under surface of the throat. A pair of laterally compressed teeth protruding, in the male, between the lips at the side of the beak; not visible in the female. Rudimentary functionless teeth present in the gum both of the upper and lower jaws."

From the second Shetland specimen Prof. Turner was enabled to add very little to the above description, as it reached him flensed and cut into blocks; but the skin of the tail was almost black on both the dorsal and ventral surfaces, and on either surface a mesial keel was present. The posterior border of the tail was convex and not notched in its middle part, and

* 'Journal of Anatomy and Physiology,' April 1882. pp. 462, 463.

the blowhole in this individual was transverse instead of semilunar. The flipper was 1 foot 10 inches in length from the head of the humerus, and its greatest diameter 6¼ inches; it came almost to a point at the tip, the anterior border being slightly convex; the posterior border for 7 inches from the axilla was almost straight and then rapidly sloped forward to the tip; the colour on both surfaces was "like that of a well-blackened boot." The above particulars comprise all that is known with certainty with regard to the appearance of this singular animal.

The Ziphioid whales to which the genus *Mesoplodon* belongs were very numerous in the seas surrounding Great Britain during the period in which the Suffolk Crag was deposited, as testified by the abundance of their remains found in that formation; but in the present day, with the exception of one species of *Hyperoodon*, which congregates in considerable numbers in the Arctic seas in summer, and which not unfrequently makes its appearance on the British coasts in autumn, the other members of the subfamily are amongst the least-known of any of the Cetaceans found in our seas. Of the genus *Mesoplodon* only one species has hitherto been met with in the North Atlantic, viz. that which forms the subject of this notice, unless the Cetacean found dead in the British Channel about the year 1840 (the skull of which is in the Museum at Caen) and described by Gervais under the name of *M. europæus*, should prove to be distinct; but of the seven or eight species known, three at least are well established, and some fairly abundant in the seas extending from the Cape of Good Hope to New Zealand; others are of great rarity and at present little known. Prof. Flower has contributed an excellent monograph of this genus, which will be found in the tenth volume of the 'Transactions of the Zoological Society,' in which he points out certain well-marked characters common to the whole genus, subject to slight specific modifications; one of these is the remarkable mandibular tooth already referred to, and which, whether situated near the apex of the mandible as in *M. Hectori* or near the hinder edge of the mandibular symphysis as in *M. bidens*, always forms a good distinctive character. In the fully adult male of the species under consideration these teeth project about 2 inches above the gum, are laterally compressed, triangular in form, the apex at first directed backwards and then slightly forwards, the tooth projecting tusk-like outside the upper lip. In *M. Layardi* this singular form of tooth reaches its extreme, and is described by Prof. Turner * as reaching a

* "Form and Structure of the Teeth of *Mesoplodon*," 'Journal of Anatomy and Physiology,' xiii. p. 460.

total length of 14 inches, 6¼ of which were included in the alveolus and gum; at the point at which it emerged from the alveolus it was 3½ inches in breadth, and continuing its growth in strap-like form "it curved obliquely backwards, upwards, and inwards," the two teeth crossing each other on the dorsum of the beak, thus greatly restricting the motion of the lower jaw.

In addition to the two remarkable teeth just described a number of rudimentary and functionless concealed teeth have been detected in *M. bidens*, and in a New-Zealand species (*M. Grayi*) such teeth are said to be constant; with regard to this interesting fact Prof. Flower observes *, "We have here the permanent retention of a condition intermediate between that of the irregular, completely concealed, probably only temporary, and quite functionless teeth, mentioned above [*M. bidens*], and the normal state of dentition of the true Dolphins, and it is especially interesting that this should have been met with in a member of the genus otherwise least modified from the Dolphins."

Prof. Turner, in 1882, enumerates thirteen instances of the occurrence of this species, three of which were met with in Scotland, two on the Irish coast, and the remainder on the Continent or in the United States. Since that time one other Scotch specimen has occurred, also the subject of this communication, which is believed to be the first record of its occurrence on the English coast. The following is a list of the known occurrences, with particulars as to the locality &c., compiled from Prof. Turner's paper and other sources.

1. The first recognized example of this species came on shore at Brodie, in Elginshire, in the year 1800; the imperfect skull and a drawing of the animal were forwarded to the late Mr. Sowerby, by whom they were figured and described in his 'British Miscellany,' vol. i. p. 1, in 1806, under the name of *Physeter bidens*. It was an adult male 16 feet in length. From Mr. Sowerby's collection the skull passed through Dr. Buckland to the Oxford Anatomical Museum, where it now is.

2. A female 15 feet long, stranded at Havre on Sept. 9, 1825, the skull of which is preserved in the Paris Museum. It was described by De Blainville (Nouv. Bull. Sci. Soc. Philom. t. iv. p. 139).

3. A male from Sallenelles, Calvados, in the north of France, also in the year 1825, the skull and part of the skeleton of which are preserved in the Museum of Caen.

* Trans. Zool. Soc. x. p. 425.

4. A young female stranded at Ostend on 31st Aug., 1835, the complete skeleton of which is in the Brussels Museum.

5. The second British specimen was stranded in the Bay of Brandon, Kerry, on the 9th of March, 1864. It was a male 15 feet in length; unfortunately it was destroyed before it was seen by a naturalist; but Dr. Busteed succeeded in securing part of the head, which had been removed immediately behind the frontal portion of the skull, and photographed it in several positions while yet quite fresh. The photographs were reproduced in a paper by Mr. Andrews, published in the 'Transactions of the Royal Irish Academy,' xxiv. 1869.

6. The mandible of a specimen taken on the Norwegian coast is preserved in the Museum of Christiania, and figured and described by Van Beneden (Bulletin de l'Acad. Royal de Belgique, t. xxii. 1866).

7. A specimen, believed to be the first met with in America, was standed on Nantucket Island, Mass., U. S., about the year 1867, the cranium of which is in the Harvard College Museum.

8. A complete skeleton of a male in the Gottenburg Museum from Skagerak, Norway, in 1869.

9. A second Irish specimen occurred 31st May, 1870, five or six miles from the site of the first capture in Brandon Bay, and was also observed by Dr. Busteed. It was a male 17 or 18 feet long, and, like the previous specimen, was hacked to pieces so as to be of little service to science. From each tooth of this animal depended a bunch of cirripeds believed to be *Conchoderma aurita*. It is recorded by Mr. Andrews (Proc. Royal Irish Acad. ser. 2, i. p. 49).

10. The skull of a specimen preserved in the Museum of Science and Art, Edinburgh, is thought by Prof. Turner, "not unlikely" to have belonged to an animal captured in the Scottish seas (Trans. Royal Soc. Edinburgh, May 20, 1872).

11. A female captured on 3rd Feb., 1880, at Herringholm Strand, on the east coast of Jutland, was described by Prof. Reinhardt, but the skeleton was not preserved.

12. On the 9th Nov., 1881, a male about 15 feet long was found floating dead off Vanholmen, near Marstrand, Sweden; like previous specimens it was partly flensed before being seen by Dr. Malm, who, however, has given an excellent description of what he saw (quoted by Prof. Turner); he also secured the skeleton for the Gottenburg Museum.

13. This specimen forms the subject of a communication by Prof. Turner to the Royal Society of Edinburgh, under the date of Jan. 30, 1882, and reprinted in the 'Journal of Anatomy and Physiology' for April 1882, p. 458 *et seq.* It

was seen struggling near the shore in Urafirth Voe, Northmavine, on the west coast of the main island of Shetland, in April 1881, and speedily captured. Mr. Thomas Anderson, who saw the animal in the flesh, furnished Prof. Turner with a description of its external appearance, and procured the skeleton for the Anatomical Museum of the University of Edinburgh, where it is now preserved, having been fully described in the communication before referred to. The animal was a male about 14 feet long.

14. On the 25th May, 1885, a second Shetland specimen of this species was taken in Voxter Voe, about 13 miles from the spot where the first specimen was secured; it was a male about 15 feet 8 inches long, and is said to have been accompanied by a young one about 7 feet long, which escaped. This specimen, although it was flensed and cut into sections before it reached Prof. Turner, enabled that anatomist to give some very valuable information on the anatomy of the soft parts as well as to supply some deficiencies in his previous description of the skeleton. This he did in a communication to the British Association at the Aberdeen meeting, printed in the 'Journal of Anatomy and Physiology' for Oct. 1885, p. 144 *et seq.* The complete skeleton of this adult male is articulated in the Anatomical Museum of the University of Edinburgh.

15. The most recent occurrence of this species is the specimen referred to in the early part of this communication.

VII.—*On* Vulsella, *a Genus of Acephalous Mollusca.* By ALFRED HANDS COOKE, M.A., Curator in Zoology, Museum of Zoology and Comparative Anatomy, Cambridge.

AT least nineteen recent species of the Genus *Vulsella* have been described. Lamarck, to whom the genus is due, described six (*lingulata*, *hians*, *rugosa*, *spongiarum*, *mytilina*, *ovata*: Anim. sans Vert. ed. 2, vol. vii. p. 266 f.). Conrad added one (*Nuttallii*); one (*Hügelii*) appears due to Parreiss; while Reeve, in the 'Conchologia Iconica,' vol. xi., described eleven new species (*pholadiformis*, *isocardia*, *tasmanica*, *attenuata*, *crenulata*, *limæformis*, *phasianoptera*, *rudis*, *linguafelis*, *corollata*, *trita*) from the Cumingian collections, the types of which are now in the British Museum.

I am not aware that any note of suspicion, save one, has ever been sounded with regard to the genuineness of any of these so-called species. That was by G. B. Sowerby the elder, in 1825. Writing after Lamarck's work had been

published, and consequently when only six species were known, he says ('Genera,' *Vulsella*), "On account of the irregularity of the shells in this genus we think it must be extremely difficult to distinguish the species, and consequently we believe that several mere varieties are raised to the rank of species." My own opinion, as will be gathered from the detailed examination which follows, agrees strongly with the view here expressed, and the more so because the number of species since Sowerby's time has been more than trebled. That not a single one of the so-called species of Reeve will bear examination will, I think, be admitted by any one who can appreciate what a variable genus means, for his types can be investigated at the British Museum. Here is a case of a genus whose usual habit is to attach itself to various marine plants, growing with their growth and shaping itself with their shape. The inevitable result of this is a never-ending variation, not merely in shape but in size, colouring, marking, and texture; and if we pursue Reeve's system to its logical conclusion we shall have as many different species of *Vulsella* as there are specimens.

But I go further than merely obliterating the Reevian species. I hold that two at least of those of Lamarck, viz. *spongiarum* and *ovata*, are absolutely identical, while the form *mytilina*, Lam., constitutes a passage between these and *lingulata*, from which *hians*, Lam., differs only in point of size. In the case of an "attached" genus there is not only great variation of shape and size, but it will be found that the less a specimen is attached or imbedded (in sponge, seaweed, &c.) the less irregular it is. Specimens taken from a mass of sponge containing hundreds of shells will be more irregular than specimens which occur in less populous or in less confined situations. An instance of this may be given from a mollusk common on our own shores. The well-known *Tapes pullastra*, L., when in a free state, is as regular in shape, size, and sculpture as any other species of the genus; but when it occurs in shells, stones, or clay, as the variety *perforans* (and no one has ever seriously disputed the generic identity of the form with *pullastra*), its shape and texture undergo variations which differ extensively from one another and from the type. The concluding remarks of Rumphius, quoted below under *V. lingulata*, seem to illustrate this point.

My impression, formed by the comparison of dozens of specimens with one another, is that the recent species of *Vulsella* may be reduced to at most three. The free or unattached form is the well-known *lingulata*, in which the shell not only attains its maximum of size, but develops the

characteristic red longitudinal lines to the greatest extent, and is at the same time freest from those scaly foliations which so often denote a cramped and distorted growth. Next comes the form figured by Delessert as the Lamarckian *rugosa*, in which the beaks are prominent, the surface scaled, but there is no manifest distortion; the general shape may be compared to that of a *Septifer nicobaricus*. Finally come the great mass of the "species," the names given, mainly by Reeve, to the inevitably varying shapes of the attached or confined shells, of which *spongiarum*, Lam., may be regarded as the type; *ovata*, Lam., representing the extreme of compression and distortion.

A detailed list of the "species" follows.

1. *Vulsella pholadiformis*, Reeve (Conch. Icon. vol. xi. *Vulsella*, pl. i. fig. 1).

Hab. Ceylon (*E. L. Layard*).

Type (the only specimen known) in Brit. Mus.

Manifestly a debased and distorted shell, probably taken from a crack or hole in a rock where it had not room to expand. Sculpture, where any can be detected, the same as in the form *spongiarum*, Lam. The "species" doubtless belongs to that form.

2. *Vulsella isocardia*, Reeve (Conch. Icon. *ut sup.* pl. i. fig. 2).

Hab. Red Sea (*Reeve*), Suez (*Issel*, Malac. del Mar Rosso, p. 100; *MacAndrew*, Ann. & Mag. Nat. Hist. 1870).

Type in Brit. Mus.

"The surface of this species," remarks Reeve, "is almost wholly overlaid with a plaiting of finely pointed scales, the umboes being convoluted inwards as in *Isocardia*." It is to be remarked, however, that the scaly surface of the shell is more or less a characteristic of the whole genus, while the position of the beaks, and the amount of curvature which they describe, depend upon the compression to which the shell is subjected in its various stages of growth. Belongs to the form *spongiarum*, Lam.

3. *Vulsella tasmanica*, Reeve (Conch. Icon. *ut suprà*, pl. i. fig. 3).

Hab. Tasmania (*Reeve*; *Tenison-Woods*, in Proc. Royal Soc. Tasm. 13 Mar. 1877), S. Australia (*id. ib.*), Port Jackson (*Angas*, in P. Z. S. 1867, p. 930).

Type in Brit. Mus.

Shape inclining towards that of *isocardia*, i. e. more

rounded than *spongiarum*, with the want of scaly sculpture that characterizes *mytilina*. This latter fact, however, is of no account, as the type specimen is an old one (cf. *trita* below), and the scales have probably been rubbed off. Tenison-Woods (*ut sup.*) distinctly says it is "squamose and closely striate."

The Tasmanian and S. Australian form of *spongiarum*; Lamarck calls it *ovata* (see no. 18).

4. *Vulsella mytilina*, Lamarck (An. sans Vert. ed. 2, vol. vii. p. 268).

Chemnitz, Conchylien-Cabinet, 1782, tab. ii. figs. 8, 9.
Vulsella mytilina, Reeve, Conch. Icon. *ut sup.* pl. i. fig. 4.

Hab. —— (*Lam.*), Red Sea (*Rüppell*), Suez (*Issel, MacAndrew*).

Why Reeve should have substituted his obscure Latin description for Lamarck's decidedly clearer one I cannot understand. His figure is from a wretchedly worn specimen, which is in the British Museum. Lamarck's memorandum, "grande coquille blanche, ayant des stries d'accroissement transverses et concentriques," exactly describes the appearance of this shell, which I regard as a well-marked variety of *lingulata*, distinguished from all other varieties by its greater size, its comparative smoothness of surface, its slightly greater rotundity, and its want of colouring. It is the *Mya vulsella minor* of Chemnitz, "der kleinere Bartkneiper," "die kleinere Kornzange" of the same author, who recognizes its close affinity to *lingulata* by referring to Rumphius's description of it. Now Rumphius only recognizes *lingulata*.

5. *Vulsella attenuata*, Reeve (Conch. Icon. *ut sup.* pl. i. fig. 5).

Hab. Red Sea (*Reeve*), Suez (*Issel, MacAndrew*).
Type in the Brit. Mus.

An obvious link between *lingulata* and *mytilina*, having the general shape, even to exaggeration, of the former, and the absence of marked sculpturing of the latter.

6. *Vulsella lingulata*, Lamarck (An. sans Vert. ed. 2, vol. vii. p. 269).

Lister, Hist. Conch. tab. 1055, fig. 10 (1685). He called it *Musculus κτενώδης*, the comb-shaped muscle, and, curiously enough, regarded it as a freshwater shell, placing it upon the same *mantissa* as such "*cochleæ et bivalvia aquæ dulcis*" as *Paludina contecta*, *Melania amarula* (which he calls *Buccinum aculeatum*), and a large *Pirena*.

Rumphius, 'Amboinsche Rariteitkamer,' pl. xlvi. A (1705). A very interesting description of the habitat of the shell is subjoined, which I will translate:—"These are smaller [than some bivalve which I cannot make out], about a finger long, with folded and notched edges, on the outside dark grey and scaly, some pure reddish; the upper valve has a raised back; with the lower valve they embrace the little sticks or reeds [does he mean seaweeds and sponges or brackish-water plants?] which have stood about half a year in the sea. This is done by their many little feet or little arms, which embrace the edges of these sticks in the same way as we see at the roots of *Polypodium*. On these reeds they grow in masses, one upon the other, so that we have to cut off the sticks with them, *but the most beautiful are those which grow singly*. They are also found on the roots of all kinds of *Mangium fruticans*, but these are sharp and very much notched."

Gualtieri, 'Index Testarum,' tab. xc. fig. 4 (1735). He describes it as "*Concha longa incurvata, striis seu lineis undatim signata, obscure tophacea, intus argentea.*" The shell figured is not so large as the type, but is quite unmistakable.

Linnæus, Mus. Tessinianum, no. 1, p. 116, tab. vi. fig. 3, *Pinna lingulata, linguiformis, subfalcata.*

Linnæus, Syst. Nat. ed. 12, p. 1113, *Mya vulsella.*

Chemnitz, 'Conchylien-Cabinet,' 1782, tab. ii. figs. 10, 11, gives it the familiar names of der grössere und grösste Bartkneiper, die Korn-, Haar- oder Bartzange, die Bohnenschoote (Valentyn, Verhandeling, 1754, had called it "die Bohnenschooten doublette"). He says it is "fünf Zoll drey Linien lang, beynahe anderthalb Zoll breit."

Born, Mus. Cæs. Vindob. Test. p. 22, *Mya vulsella* (not figured).

V. lingulata, Lamarck, Anim. sans Vert. ed. 2, vol. vii. p. 267.

Sowerby, Genera (1820-25), "The Hound's-ear Oyster," gives three figures, all as of *lingulata*, but two are of the form *mytilina*, while a figure of a cluster is of *rugosa*.

Wood, 'Index Testaceologicus' (Hanley), *Ostrea*, fig. 84.

Crouch, Introd. to Lamarck's 'Conchology,' p. 21, pl. xii. fig. 10.

Reeve, Conch. Icon. vol. xi. *Vulsella*, pl. i. fig. 6.

V. hians, Lamarck (not Reeve), *ut sup.* p. 267. no. 2.

Hab. Indian Ocean (*Lamarck*), Suez (*Issel, Fischer*, Journ. de Conch. 1871, p. 212).

7. *Vulsella rugosa*, Lamarck (An. sans Vert. ed. 2, vol. vii. p. 269).

Vulsella rugosa, Delessert, tab. xviii. fig. 3 : Hanley, Recent Shells.

Hab. ——? (*Lam.*), Red Sea, Suez (*Issel*, *MacAndrew*), Persian Gulf (*MacAndrew*, MS.).

Not the *V. rugosa* of Reeve (Conch. Icon. pl. i. figs. 7, 8). Lamarck describes his *rugosa* as follows:—

"*V. testa oblonga, subarcuata, planulata, rugis longitudinalibus, striisque transversis arcuatis, rugas decussantibus*," from which little could be made out, were not the following addition made:—"Celle-ci est plus aplatie que celle qui précède (*hians*, Lam.), non ou presque point baillante, *et a le bord antérieur très courbé*." Now Reeve's figures represent a shell by no means "courbé," either on the anterior or the posterior edge, while his fig. 7, instead of being broader, is considerably narrower than his idea of Lamarck's *hians*. The true *rugosa* of Lamarck is that figured by Delessert (unfortunately the only *Vulsella* he figures), and corresponds exactly to that form described by Reeve as *corollata* and, with very slight modifications, as *phasianoptera*.

8. *Vulsella crenulata*, Reeve (Conch. Icon. *ut sup.* pl. i. fig. 9).

Hab. Red Sea (*Reeve*), Suez (*Issel*, *MacAndrew*).

A name for another of the numerous forms which belong to *spongiarum*, Lam. (=*rugosa*, Reeve). Closely akin to *isocardia*, Reeve. Even Issel (Mar Rosso, p. 100) remarks on its close relation to *spongiarum*, and hazards the conjecture "forse non ne differisce specificamente."

9. *Vulsella limæformis*, Reeve (Conch. Icon. *ut sup.* pl. ii. figs. 10 *a*, 10 *b*).

Hab. Port Adelaide, S. Australia (*Reeve*), St. Vincent's Gulf (*Angas*, in P. Z. S. 1865, p. 653).

Type in Brit. Mus.

A careful examination of the type leads to the conclusion that there is absolutely no specific distinction between this form and *tasmanica*, Reeve, +*rudis*, Reeve, the Australian and Tasmanian form of the common *spongiarum*, Lam.

10. *Vulsella phasianoptera*, Reeve (Conch. Icon. *ut sup.* pl. ii. fig. 11).

Hab. Australia (*Reeve*). (See no. 13.)

11. *Vulsella rudis*, Reeve (Conch. Icon. *ut sup.* pl. ii. fig. 12).

Hab. Swan River (*Reeve*), Port Lincoln (*Angas*, in P. Z. S. 1865, p. 653).

The affinities of this form have been laid down under no. 9.

12. *Vulsella lingua-felis*, Reeve (Conch. Icon. *ut sup.* pl. ii. figs. 13 *a*, 13 *b*).

Hab. ——? (*Reeve*), Suez (*MacAndrew*).

Only another name for a form of *spongiarum*, Lam.

The type is in the Brit. Mus., and is, save for the sculpture being cleaner and the shell in better preservation, undistinguishable from *crenulata*, Reeve.

13. *Vulsella corollata*, Reeve (Conch. Icon. *ut sup.* pl. ii. fig. 14).

Hab. Zanzibar (*Reeve*), Suez (*MacAndrew*).

This is the *V. rugosa* of Lamarck, and it is extraordinary how Reeve, with Delessert's figure before him, could have redescribed it. Delessert's description of *rugosa* ("comme treillissée par des rugosités longitudinales croisées par des stries d'accroissement arquées") might serve for a translation of Reeve's description of his *corollata* ("concentrically densely laminated, laminæ crenulately scaled"). *V. phasianoptera*, Reeve, is merely a slightly attenuated form of the same species.

14. *Vulsella spongiarum*, Lamarck (Anim. sans Vert. ed. 2, vol. vii. p. 268).

Hab. Indian Ocean? (*Lam.*), Suez (*Reeve, Issel, MacAndrew*).

Not the *V. spongiarum* of Reeve. Lamarck's description is as follows:—"*V.* testa oblonga, *recta*, *basi subattenuata*, intus argenteo-violacescente; rugis transversis concentricis: longitudinalibus obsoletis." Reeve, however, on what authority I am puzzled to imagine, describes Lamarck's species thus:—"*Vul.* testa oblonga, *arcuata*, *ad basin latiuscula*, umbonibus divergentibus, radiatim minutissime crenulento-squamata; fuscescente,"—that is to say describing the shell as curved, while Lamarck expressly said it was straight, and as being somewhat broad at the base, while Lamarck takes the trouble to remark that the base is somewhat attenuated. Besides this Reeve throws in the diverging umboes, of which Lamarck says not a word; and one would gather from Reeve's description that the striking feature about the striæ was that they were radiating, whereas Lamarck goes out of his way to say that the longitudinal wrinkles are obsolete, while it is the concentric ones that claim attention!

My idea of Lamarck's *spongiarum* is the left-hand shell of the pair figured by Reeve as 13 *b*. This is the form commonly found, as indeed Reeve there represents it, imbedded in the sponge, whence its name.

Lamarck inquires, "An Chemn. Conch. 6, tab. ii. f. 8, 9?" I have already shown reasons for thinking that this figure represents *V. mytilina.*

15. *Vulsella hians*, Lamarck (Anim. sans Vert. ed. 2, vol. vii. p. 2).

Hab. Indian Ocean? (*Lamarck*).

Here again Reeve has come to complete grief in his identification of the Lamarckian species. That author, by his references to Lister (tab. 1055. fig. 10), to Gualtieri (tab. 90 H), and to Chemnitz (tab. 2. fig. 10), had made it abundantly clear that his *V. hians* was nothing more than *V. lingulata* on a slightly smaller scale. Yet Reeve, with these references before him, and undeterred by the fact that Lamarck gave 58 to 60 millim. as the measurement of his type, figures a thick stumpy shell, which actually measures less than his idea of *spongiarum*, to which Lamarck assigns 44 millim. as the length.

16. *Vulsella trita*, Reeve (Conch. Icon. *ut sup.* pl. ii. fig. 17).

Hab. Red Sea (*Reeve*), Suez (*Issel*).

Only those who have seen the type of this shell (it is in the Brit. Mus.) can realize to what a depth species-makers can descend. Here we have a wretched beach-worn lump, which looks as if it had been at the bottom of the sea for 500 years, and had then been rejected because the sea was ashamed to keep it any longer! No wonder that it is "a more solid species than usual, with no perceptible indication of crenulated scales." One of the many forms of *spongiarum*, Lam.

17. *Vulsella ovata*, Lamarck (Anim. sans Vert. ed. 2, vol. vii. p. 268).

Reniella dilatata, Swainson, Malac. p. 386, fig. 127.
Vulsella ovata, Hanley, Recent Shells (the only *Vulsella* figured).

Hab. Seas of New Holland (*Lamarck*).

Reeve has not figured this species, but has replaced it by his *tasmanica*. I regard *ovata*, then, as the Australian form of *spongiarum*.

18. *Vulsella Nuttallii*, Conrad (Journ. Acad. Nat. Sci. Philad. vii. p. 257, t. xx. fig. 10).

Hab. Friendly Is. (*Conr.*).

"Very irregular, with concentric lamellar striæ near the beaks; cavity of the interior deeply concave towards the hinge, bounded at the other extreme by a concentric ridge, the rest of the inner surface obliquely divided lengthwise by an obtuse rib; 1–½. Possibly a distorted specimen." I take these

remarks from Hanley, 'Recent Shells,' and see no reason to regard the species as anything else than an abnormal form of *spongiarum*, Lam.

19. *Vulsella Hügelii*, Parreiss.

Hab. Coast of New Holland (*Martini*).

I know nothing of this species. From the description in an incomplete monograph of Martini, and from a specimen in the Brit. Mus. (labelled *Hügelii*, d'Essing, India), it would seem not to differ from *spongiarum*, Lam.

VIII.—*Description of an apparently new Species of* Scincus *from Muscat.* By JAMES A. MURRAY, Curator of the Kurrachee Museum.

Scincus muscatensis.

Snout rather long, longer than that of *Scincus arenarius*, Murray (Vert. Zool. Sind), the space between the eyes being less than the length of the snout. Rostral spatulate, twice as broad as high, rounded behind and in contact with the prefrontal; supranasals separate; nostril between the first labial, the supra- and the postnasal, and the lateral angle of the rostral; two postnasals, the posterior larger; one large preocular or loreal equalling the prefrontal in length, and forming a suture with the hind edge of the second postnasal, the fourth and fifth upper labials, the first superciliary, and a large shield in front of the lower eyelid; the latter five-sided and as broad at the base as it is high; upper labials eight or nine. Prefrontal six-sided, its front angles in contact with the supranasals and rostral, its lateral angles in contact with the postnasals on each side, and the hind angles in contact with the postfrontals. Postfrontals broadly in contact together, rather rounded in front and subtriangular behind; their lateral angles are in contact on each side with the large preocular plate and the hind outer angles form a suture with two thirds only (or the whole in some) of the first superciliary. Vertical once and a half its greatest breadth, extending behind as far as the outer edge of the fourth superciliary.

Dorsal scales 18, reckoned from above the angle of the abdomen; 26 rows round the middle of the body. The fore leg laid forward reaches the eye; the hind leg laid forward reaches the tips of the fingers. Two large preanal shields.

Colours as in *Scincus arenarius*; a mesial dark spot on each scale edged on both sides with yellowish white, forming inter-

rupted longitudinal bands; a dark streak from the nostril to the eye; 8 to 10 vertical reddish-brown streaks along the sides, beginning from in front of the forearm. Young without these vertical streaks.

From *Scincus arenarius* it differs in the shape of the prefrontal, which is six-sided instead of heart-shaped; in having 26 instead of 28 rows of scales round the body; in the postfrontals extending behind to only two thirds, or in some specimens the entire width of the first superciliary; in having two small postnasals instead of one long one; also in the first suborbital scale in front of the lower eyelid being as broad at the base as high, and five-sided instead of elongate, and nearly twice its greatest breadth.

These differences are exhibited in all my specimens, thirteen in number.

The following Table will exhibit the differences between this and other species. Of *S. Hemprichii* I have no description.

	Rostral and prefrontal.	Supra-labials.	Suborbital labials.	Dorsal scales.	Scales round body.	Superciliary shields.	No. of speci-
eocensis *	In contact	7	5th & 6th	16	?	5	
itranus *......	do.	8	?	?	?	5	
fficinalis * ...	do.	8	6th & 7th	18	?	6	
·enarius	do.	8	½ of 5th, 6th, & 7th	20	28	6	7
uscatensis	do.	8-9	6th & 7th	18	26	6	1
mirostris	Not in contact	8	6th & 7th	20	28	6	8

IX.—*On the Geodephagous Coleoptera collected by Mr. George Lewis in Ceylon.* By H. W. Bates, F.R.S.

The collection of Coleopterous insects made by Mr. George Lewis during a five months' residence in the island of Ceylon in the cold season of 1881–82, viz. from November 27th to

* From Blanford's notes in P. Z. S. 1881, p. 677.

April 27th, comprised about 1600 species. When duly worked out this will form by far the largest contribution yet recorded to our knowledge of the Ceylonese fauna in this department. The present paper treats of the section Geodephaga. For an account of the localities visited and the habits and relations to their surroundings of the Coleoptera, I must refer the reader to Mr. Lewis's interesting paper entitled "On a Visit to Ceylon," in the 'Transactions of the Entomological Society,' 1882, p. 475.

With regard to the list of Ceylonese Coleoptera published by Walker in this journal in 1858 and 1859, I have endeavoured, with the aid of Mr. C. O. Waterhouse, to identify the species by inspection of the type specimens in the British Museum. The diagnoses attached to the names are no better than a haphazard collection of words as far as their use is concerned in determining the species, and their reference in so many cases to well-known genera is generally ridiculously wrong and pure guesswork. Under these circumstances I consider Walker's names as entitled to no more authority than those of a catalogue. When therefore the same species has been since well described under another name I have not replaced it by Walker's; but in species not so described I have adopted for convenience' sake, and not on the ground of priority, Walker's names whenever his brief diagnosis does not flatly contradict the type specimens. Some remarks on species not taken by Mr. Lewis will be found at the end of this paper.

Family **Cicindelidæ.**

Cicindela lacrymans.

Cicindela lacrymans, Schaum, Journ. Ent ii. p. 57.
Cicindela discrepans, Walker, Ann. & Mag. Nat. Hist. ser. 3, ii. 1858, p. 202.

Near Colombo. One example.

Cicindela catena.

Cicindela catena, Fabr. Syst. Ent. p. 226.

Colombo, on roads away from the sea.

Cicindela sumatrensis.

Cicindela sumatrensis, Herbst, Kaf. x. p. 179, t. clxxii. fig. 1.

Colombo, on banks of rivers.

Cicindela viridilabris.

Cicindela viridilabris, Chaudoir, Bull. Mosc. 1852, i. p. 24.

Colombo.

One male example, agreeing with Chaudoir's description, except that the labrum is coppery with greenish reflections rather than "vert métallique," and the head and thorax coppery, subopaque, with green sides, and not "vert bronzé brillant." Chaudoir had only a single female example before him from the "Indes Orientales" in drawing up his description, and it is doubtful if the above-mentioned differences indicate more than individual or local variations.

Cicindela quadrilineata.

Cicindela quadrilineata, Fabr. Sp. Ins. i. p. 285.

Near Colombo. One example.

Cicindela biramosa.

Cicindela biramosa, Fabr. Sp. Ins. i. p. 286.

Colombo; common on the sandy beach.

Derocrania nematodes.

Derocrania nematodes, Schaum, Journ. Ent. ii. p. 61, t. iv. fig. 1.

Bogawantalawa.

Derocrania concinna.

Derocrania concinna, Chaudoir, Bull. Mosc. 1860, iv. p. 298.

Kandy.

Distinguished from *D. nematodes* by the elytra being covered to the apex with large separate punctures instead of finely transverse-rugulose. Mr. Lewis's specimen differs from Chaudoir's description in the thorax being dark purplish red instead of black.

Derocrania Nietneri.

Derocrania Nietneri, Motschulsky, Et. Ent. 1859, p. 25, 1862, p. 23 (=*lævigata*, Chaud. 1860, *raphidioides*, Schaum, 1861).

Balangoda ridge.

Var. *Derocrania obscuripes.*

Legs darkish testaceous red; apices of the tibiæ and tarsi darker piceous.

Bogawantalawa.

In the male the posterior part of the elytra is more gradually and less widely dilated and much less convex above than in the female. It varies, however, a little in both sexes. The sulci of the forehead are in some examples of both forms distinctly traced, in others quite obsolete.

In the var. *obscuripes*, which Mr. Lewis found confined to one tree and to be slower in its motions than the type form, the legs appear to be a little shorter.

Collyris Saundersii.

Collyris Saundersii, Chaudoir, Ann. Soc. Ent. Fr. 1864, p. 496?

Colombo.

One example agreeing with the description above cited, except that the coxæ are red like the thighs, and not black. In a genus like *Collyris*, where the extent of specific variation is at present ill understood, it would be inexpedient to found a new species on this differential character.

Collyris —— ?

One example with the antennæ deficient, and the species consequently undeterminable.

Collyris punctatella.

Collyris punctatella, Chaudoir, Ann. Soc. Ent. Fr. 1864, p. 525.

Balangoda. One example, March 13th.

Collyris ceylonica.

Collyris ceylonica, Chaudoir, Ann. Soc. Ent. Fr. 1864, p. 520.

Bogawantalawa, April 3rd.

Family **Carabidæ.**

Subfamily *Scaritinæ.*

Oxylobus quadricollis.

Oxylobus quadricollis, Chaudoir, Bull. Mosc. 1855, i. p. 7.

Colombo.

Oxylobus costatus.

Oxylobus costatus, Chaudoir, Monogr. des Scaritides (1880), p. 15.

Colombo.

Coptolobus omodon.

Coptolobus omodon, Chaudoir, Monogr. des Scaritides (1880), p. 42.

Hadley, Dikoya.

Coptolobus glabriculus.

Coptolobus glabriculus, Chaudoir, Bull. Mosc. 1857, ii. p. 60.
Scarites subsignans and *S. obliterans*, Walker, Ann. & Mag. Nat. Hist. ser. 3, ii. 1858, p. 203.

Nuwara Eliya and Horton Plains.

Having examined the types of both Walker's species I have found not the slightest difference between them, both specimens being referable to *Coptolobus glabriculus*, Chaud.

Coptolobus taprobanæ.

Coptolobus taprobanæ, Chaudoir, Monogr. des Scaritides (1880), p. 42.

Colombo.

Distichus minor.

Scarites minor, Nietner, Ann. & Mag. Nat. Hist. ser. 2, xix. p. 244.

Colombo, in marshes.

Scarites indus.

Scarites indus, Olivier, Ent. iii. 36, p. 9, t. i. fig. 2, *a*, *b*.

Colombo.

Scarites ceylonicus.

Scarites ceylonicus, Chaudoir, Monogr. des Scaritides (1880), p. 85.

Colombo.

Clivina indica.

Clivina indica, Putzeys, Monogr. des Clivinides, p. 67, = *rugosifrons*, Nietner, Ann. & Mag. Nat. Hist. ser. 2, xix. (1857), p. 245.

Colombo; abundant under dung in the coco-palm groves by the sea.

Clivina Parryi.

Clivina Parryi, Putzeys, Postscr. ad Cliv. Monogr. p. 69.

Colombo, in marshes.

Clivina elongatula.

Clivina elongatula, Nietner, Ann. & Mag. Nat. Hist. ser. 2, xix. p. 241.

Colombo, in marshes.

Clivina rufipes.

Clivina rufipes, Motschulsky, Bull. Mosc. 1861, i. p. 102; Putzeys, Révis. Gen. p. 184.

Colombo, in marshes.

Dyschirius ordinatus.

Dyschirius ordinatus, Bates, Trans. Ent. Soc. 1873, p. 240.

Kandy.

I can discover no difference of specific importance between a Ceylonese example and others taken by Mr. Lewis in Japan described under the above name.

Subfamily *Pelecinæ*.

Disphæricus ovicollis.

Niger, politus; antennis pedibusque testaceo-rufis, palpis flavo-testaceis; capite ante oculos elongato-oblongo; thorace subelongato-ovato, lateribus marginatis; elytris elongato-ovatis, utrinque striis octo crenato-punctatis quarum 6–7 abbreviatis et vix impressis. Long. $3\frac{1}{4}$ lin. ♀.

Anderson's Estate, Dikoya. One example, Jan. 10th.

Differs from *D. marginicollis*, Schaum, the only other described Asiatic species, by its larger size and the long, narrow, ovate form of its thorax. In the latter feature it differs also from the African species. The thorax attains its greatest width immediately behind its anterior angles, which are depressed and applied closely to the sides of the neck; it continues thence of nearly the same width to beyond the middle, whence it narrows very gradually to the base; the sides are very distinctly margined, the sharp marginal groove having a setiferous puncture at about its middle, and the posterior declivity of the convex and impunctate surface is nearly vertical. The elytra are also much narrower than in the other known species; the first five striæ from the suture are deeply impressed, the first and second uniting near the base and thence continuing to the basal margin, which the third also reaches, whilst the fourth and fifth terminate before the base, the fifth joining the sixth behind and terminating at about the middle of the elytron. None of the striæ except the marginal one quite reaches the apex.

Subfamily *Panagæinæ*.

Epicosmus Castelnaui.

Epicosmus Castelnaui, Chaudoir, Essai Monogr. s. l. Panagéides (1878), p. 32, = *Panagæus bifasciatus*, Casteln. Et. Ent. p. 155.

Colombo.

Subfamily *Chlæniinæ*.

Chlænius circumdatus.

Chlænius circumdatus, Brullé, Rev. Ent. Silberm. iii. p. 283; Chaudoir, Monogr. des Chléniens (1876), p. 114,=*cupricollis*, Nietner, Journ. As. Soc. Beng. 1856, p. 387.

Kandy and Colombo.

Chlænius rugulosus.

Chlænius rugulosus, Nietner, Journ. As. Soc. Beng. 1856, p. 388.

Kandy and Peradeniya.

This species was unknown to Chaudoir. All Mr. Lewis's examples answer well to Nietner's description of the peculiar sculpture of the head and thorax; but the term lunule which he applies to the apical spot of the elytra is misleading; the spot is a broad dilatation of the yellow border and resembles much that of *C. sulcatulus*.

Chlænius frater.

Chlænius frater, Chaudoir, Monogr. des Chléniens (1876), p. 261?

Kandy.

According to Chaudoir's description the thorax of his *C. frater* is of the same form as *C. vestitus*, but then he goes on to mention an important difference in the hind angles. This leaves the identification of the Ceylonese species with *C. frater* in some doubt, for though the form of the hind angles agrees with the description of *C. frater*, the outline of the thorax is certainly different, being less cordate or more narrowed in front towards the anterior angles. The punctuation is much sparser and coarser than in the thorax of *C. vestitus*. *C. frater* is from the Malabar coast.

Chlænius velocipes.

Chlænius velocipes, Chaudoir, Monogr. des Chléniens, p. 266.

Dikoya.

Agrees with Chaudoir's description founded on specimens from Siam and Dacca (not Deccan, as erroneously stated), and also with an example with which I have compared it from the Nilghiris.

Chlænius cinctus.

Chlænius cinctus, Fabr. Sp. Ins. i. p. 310; Chaudoir, Monogr. p. 185,=*pulcher*, Nietner, Journ. As. Soc. Beng. 1856, p. 387.

Colombo.

Chlænius leucops.

Chlænius leucops, Wiedemann, Zool. Mag. 2, i. p. 52; Chaudoir, Monogr. p. 71.

Colombo, in garden, April 14th.

Chlænius melanopterus.

Chlænius melanopterus, Chaudoir, Monogr. des Chléniens (1876), p. 226?

Peradeniya, in river bed.

The determination of this species is not quite satisfactory. It agrees with Chaudoir's description as far as the description is intelligible, which it is only in part, the author comparing his species simply with another new one existing only in his own collection. His specimens came from Siam; the Ceylonese species is probably therefore distinct, but in what points it is impossible to indicate.

Hololeius nitidulus.

Hololeius nitidulus, Dejean, Sp. Gen. ii. p. 341, = *Chlænius ceylanicus*, Nietner, Ann. & Mag. Nat. Hist. ser. 2, xix. p. 241.

Kandy, in sandy river beds.

Subfamily *Oodinæ*.

Oodes vilis.

Oodes vilis, Chaudoir, Bull. Mosc. 1857, iii. p. 32.

Colombo.

Subfamily *Anisodactylinæ*.

Anisodactylus dispellens.

Harpalus dispellens, Walker, Ann. & Mag. Nat. Hist. ser. 3, iii. 1859, p. 51.

Kandy.

Compared with the type specimen in the British Museum. The species agrees with European and North-American *Anisodactyli* in all essential characters, but differs much from them in facies, owing to the rounded hind angles of the thorax and the large prominent eyes and much narrower neck. In these respects it also differs from *Selenophorus orientalis*, Dej., which is also an *Anisodactylus*, or belongs to a closely allied genus, differing in the setose upper surface of the tarsi and the narrower dilated joints of the middle tarsi in the male. *Anisodactylus dispellens* is a widely distributed insect in tropical Asia, being found in Siam and at Hong Kong and Fu-chau in China.

Subfamily *Harpalinæ*.

Platymetopus senilis.

Ophonus senilis, Nietner, Journ. As. Soc. Beng. 1857, p. 150.

Colombo.

Platymetopus colombensis.

Selenophorus colombensis, Nietner, Journ. As. Soc. Beng. 1857, p. 151.

Colombo, in marshes.

This species would be almost equally well placed in the American genus *Selenophorus*, to which Nietner referred it, as in *Platymetopus*, but the short and obtuse front part of the head and flatter though not perhaps broader forehead show that it belongs to an aberrant group of *Platymetopus*, in which the head is smaller than in the typical section, and not to *Selenophorus*. The species very much resembles such species as *Selenophorus discopunctatus*; in its finely punctured elytral interstices it has less of the character of *Selenophorus* than the smooth *P. amœnus*. *Cardiaderus scitus*, Walker, Ann. & Mag. Nat. Hist. ser. 3, ii. 1858, p. 203, according to the type in the British Museum, belongs to this species.

Amblystomus (Megaristerus) indicus.

Megaristerus indicus, Nietner, Ann. & Mag. Nat. Hist. ser. 3, ii. 1858, p. 428.

Kitugalle.

Siopelus ferreus.

Elongato-oblongus, chalybeo-niger, subnitidus; palpis, antennis pedibusque rufo-testaceis; elytris brevissime pubescentibus, subcrebre punctulatis, striatis, interstitiis tertio, quinto et septimo punctis nonnullis majoribus; capite medio lævi, lateribus grosse disperse punctato; thorace breviter cordato-quadrato, angulis posticis fere rectis, disco lævi, limbo sparsim, basi utrinque crebrius, punctulato. Long. 8 millim. ♂ ♀.

Nuwara Eliya.

Like an *Ophonus* in form and punctuation, but more nearly allied to *Platymetopus*, from which the shape of the emargination of the mentum—not semiovate, but with oblique sides forming a distinct angle with the straight bottom, which is destitute of tooth—readily distinguishes it. The frontal foveæ are a little prolonged on their outer side, but do not form a stria extending to the eye. The genus is hitherto known only from tropical Africa east and west.

Barysomus Gyllenhalii.

Barysomus Gyllenhalii, Dej. Sp. Gen. iv. p. 59,=*Oosoma arenaria*, Nietner, Journ. As. Soc. Beng. 1857, p. 148.

Colombo.

Bradybænus festivus.

Bradybænus festivus, Dej. Sp. Gen. iv. p. 163,=*Calodromus exornatus*, Nietner, Ann. & Mag. Nat. Hist. ser. 3, ii. p. 181.

Bradybænus ornatus, Redtenb. Reise Novara, Ins. ii. p. 14, t. i. fig. 8.

Kandy.

Dejean did not know the locality of his specimen, but supposed it was from Senegal.

CALATHOMIMUS, nov. gen.

Gen. *Harpalo* affinis, sed corpore gracili gen. *Calatho* similis, thorace ovato plicaque elytrorum basali valde curvata etc. Caput post oculos gradatim angustatum; ante oculos quam in *Harpalo* longius, mandibulæ longiores et rectiores; foveæ frontales rotundatæ, profundæ. Palpi articulis apicalibus setosis, versus apicem angustatis. Mentum acute dentatum. Paraglossæ ligula latiores et longiores. Thorax quadrato-ovatus. Elytra oblongo-ovata, plica basali valde curvata, cum margine basali apud humeros angulum acutum efficiente; profunde striata, interstitiis tertio, quinto et septimo seriatim punctatis, punctis plerumque in striarum marginibus sitis et inconspicuis. Pedes graciles parce setosi.

♂. Tarsi quatuor antici articulis 4 mediocriter dilatatis rotundato-cordatis, plantis biseriatim squamosis.

One of the two species for which this new genus is proposed has the form of a *Calathus* or *Pristodactyla*; the pubescent third antennal joint, the simple tarsal claws, and the broad adherent paraglossæ show, however, even in the female, that it belongs to the *Harpalus* group; the plurisetose penultimate joint of labial palpi and rounded frontal foveæ indicating its place among the Harpalinæ proper rather than the Stenolophinæ.

Calathomimus maculatus.

Elongatus parallelogrammicus, niger politus; antennis, partibus oris, pedibus abdomineque apice fulvo-testaceis, elytris macula humerali striga subapicali (apud interstitia 6–8) margineque laterali rufescentibus; thorace elongato postice paullo magis quam antice angustato, lateribus arcuatis angulis posticis omnino rotundatis, margine reflexo fulvo, basi absque foveis distinctis, tota superficie sparsissime setifero-punctata, margine laterali punctis setiferis circiter 10 in serie regulari dispositis; elytris profunde lævi-striatis vel sulcatis striolaque scutellari.

Long. 11 millim. ♀.

Bogawantalawa, April 1st.

Of rather narrow oblong form, the elongate thorax as wide in front as the elytra, its hind angles rounded off, and its base fitting into the deeply sinuated base of the elytra. The elytra have a strong satiny gloss and the striæ are deeply and broadly incised, the rows of setiferous punctures crenulating the edges of the second, fourth, and sixth striæ, and the ninth interstice being rather closely punctured throughout. The humeral angles are very acute and prominent, but form no dentiform projection. The slender tarsi are not grooved on the sides.

Calathomimus consors.

Minor elytrisque magis oblongo-ovatis, niger nitidus; antennis, palpis, pedibus apiceque ventris fulvo-testaceis; thorace oblongo-ovato lateribus minus arcuatis, postice minus angustato, sparsim grosse punctato et versus angulos posticos minute punctulato, margine laterali testaceo; elytris acute striatis, humeris minus productis sed acutis, interstitiis 3–5 et 7 præcipue medio punctatis.

Long. 8½ millim. ♂.

Bogawantalawa, April 1st.

Undoubtedly congeneric with *C. maculatus*, but less elongate, and the elytra less arcuated at the base and immaculate, black, with a strong satiny gloss. The species in facies is less like a *Calathus*, and resembles more the slenderer forms of Harpalinæ.

Subfamily STENOLOPHINÆ.

Anoplogenius microgonus.

A. circumcincto brevior, niger nitidus, subtus sordide rufo-testaceus; elytris viridescentibus læte sericeo-micantibus, margine inflexo testaceo; palpis pedibusque flavo-testaceis; antennis piceis basi pallidioribus; thorace breviter cordato-quadrato, angulis posticis minutis, exstantibus, margine laterali testaceo, fovea utrinque lata et vage punctulata.

Long. 7 millim.

Colombo. Also in Siam, of larger size—9 millim.

The absence of the scutellar striole brings this species within the definition of the genus *Anoplogenius*, but the fourth joint of the four anterior tarsi in the male is not bilobed, as in that genus, the lobes of the anterior tarsi being short and broad, and in the intermediate the joint is rather cordate than bilobed. The palpi have their terminal joints subcylindrical and truncated, and the frontal linear foveæ are sunk in large depressions, as in *Anoplogenius circumcinctus*. The elytral striæ are impunctate and sharply incised, the interstices flat and more convex at the apex, near which the elytral margin is moderately sinuated.

Anoplogenius renitens.

A. microgono proxime affinis, angustior et differt thorace angulis posticis rotundatis palpisque apice obtusis nec truncatis. Supra totus sericeo-micans, thorace et elytris coloribus aureo- et viridi-relucentibus, limbo laterali vage fusco-testaceo; thorace relative angustiori quadrato, postice angustato, angulis posticis valde obtusis, rotundatis; pedibus flavo-testaceis, tibiis paulo obscurioribus; cæteris sicut in *A. microgono*.

Long. 6½–7 millim.

Colombo.

Lepithrix foliolosus, Nietner, which belongs also to the genus *Anoplogenius*, has rounded hind angles to the thorax, but it is a larger insect, dark brown, with the margins of the thorax and elytra testaceous.

Stenolophus polygenus.

Anguste oblongus, nitidus subcyaneo-relucens; palpis, antennis basi (reliquis fuscis) pedibusque flavo-testaceis; foveis frontalibus late impressis lineaque curvata usque ad oculum; thorace relative parvo postice angustato angulis posticis obtusis, foveis latis basalibus lævibus; elytris parallelis, profunde striatis apice obtusis parum sinuatis.

Long. 7 millim.

Nuwara Eliya.

A narrow species unlike any other *Stenolophus* known to me; but it agrees with this genus better than with any of its allies, the fourth joint of the two anterior tarsi of the males being narrowly bilobed and the mentum without tooth. The male tarsi are, however, only very narrowly dilated, the intermediate pair scarce perceptibly so, though having the usual hair-scales on the sides of the second to fourth joints, the fourth triangular and scarcely lobed. The head is of the same form as in *Anoplogenius circumcinctus*, the eyes being prominent and the frontal foveæ very broadly impressed. The terminal joints of the palpi taper to the apex, which is briefly truncated. The elytra have a well-developed scutellar striole and the prosternum has three bristles at its apex.

Stenolophus 5-pustulatus.

Badister 5-pustulatus, Wiedemann, Zool. Mag. ii. i. p. 58.

Colombo.

A variable species with regard to the number of red spots on the elytra. None of the Ceylonese examples have five well-defined spots; in some the posterior discoidal spot is wanting, but this variety occurs with the typical form also in

China and Japan. One of the varieties (*S. transmutans*) is peculiar in wanting the subhumeral and sutural spots and in the posterior discoidal spot being limited to two small separate spots, one on the fifth and one on the seventh interstice. I have seen this variety elsewhere only from Tranquebar. This comes very close to *S. smaragdulus*, Fab., which differs only in its bluer colour and somewhat more robust form.

Obs. The nearly-allied *S. smaragdulus* (Fab., Dej.) is also found in Ceylon. *Harpalus stolidus*, Walker (Ann. & Mag. Nat. Hist. ser. 3, ii. p. 204), according to the type specimen, belongs to this species.

Stenolophus opaculus.

S. smaragdulo affinis; sed valde differt elytris minute punctulatis, subopacis. Sat breviter oblongus; palpis, antennis pedibusque flavo-testaceis; thorace lateribus arcuatis angulis posticis omnino rotundatis, margine flavo-testaceo, foveis basalibus punctatis; elytris (♀) apice late et obtuse rotundatis vix sinuatis, valde striatis, interstitiis subconvexis minutissime punctulatis, subopacis; margine, sutura postice maculaque parva subbasali apud interstitium sextum, fulvis.

Long. 6½ lin. ♀.

Nuwara Eliya.

The terminal joints of the palpi taper to a point; the frontal foveæ are only moderately depressed; the prosternum has three bristles at its apex.

Acupalpus derogatus.

Acupalpus derogatus, Walker, Ann. & Mag. Nat. Hist. ser. 3, ii. p. 204.

Nuwara Eliya.

One example, which I refer to this species on an examination of the type, the condition of which makes it difficult to examine. It is evidently, however, an *Acupalpus*; oblong, narrow, shining black, the elytra with a slight bluish tinge; antennæ, palpi, and legs pale testaceous; tip and margins of the elytra slightly rufous.

Tachycellus lamprus.

Harpalis metallicis haud dissimilis. Supra æneescenti-niger, elytris cuprascentibus, politis; palpis, antennis pedibusque rufis; capite robusto sutura inter frontem et epistoma, lineaque curvata frontali, profunde insculptis; thorace transverso-quadrato antice rotundato-dilatato, angulis posticis rectis; elytris profunde lævi-striatis, interstitiis convexis, tertio post medium impunctato.

Long. 8 millim. ♂ ♀.

Colombo.

A large submetallic species resembling somewhat in form

the male of *Harpalus rubripes*, but distinguishable at once from all members of the true Harpalinæ group by the bisetose penultimate joint of the labial palpi and the tapering and pointed apices of the terminal joints of both labial and maxillary palpi. The upper surface is glossy and relucent, and impunctate, except the base of the thorax, which is covered with minute separate punctures. The frontal foveæ (linear and reaching the eye, as in the rest of the genus) are very deep, as is also the transverse suture separating the forehead from the epistome. The elytra are convex, moderate, sinuate near the tip, and furnished with a scutellar striole. The male has a punctured fovea in the middle (towards the base) of the first ventral segment, as in most other species of the genus.

[To be continued.]

BIBLIOGRAPHICAL NOTICE.

Crustacea Isopoda Terrestria per familias et genera et species descripta a GUSTAVO BUDDE-LUND. Havniæ: 1885. 8vo. Pp. 319.

THE publication of this work forms an era in the bibliography of terrestrial Isopod Crustacea. Specialists acquainted with the author's writings and style of description have for six years been looking forward to its appearance; and it is not likely to disappoint their expectations. Mr. Budde-Lund's identifications of species described by other naturalists are occasionally open to revision. In most instances this is due to their descriptions being insufficiently detailed and his failure to obtain access to the typical specimens; but in one case, perhaps in more than one, he has gone astray through quoting a citation at second hand, instead of looking up the reference. The notes published in the 'Annals' for November and December 1882 were apparently not seen by him until his Additamenta were in hand, and consequently the misnomers exposed in those numbers still obtain currency; but as he holds English authors on this order in very slight esteem, he may have deemed the corrections untrustworthy. His list of works cited is tolerably complete, the omissions being mostly unimportant.

Mr. Budde-Lund recognizes four families of woodlice:—Onisci, Ligiæ, Tylides, and Syspastidæ.

The Onisci comprise fourteen well-established genera arranged in two sections—the Armadilloidea with eight genera, and the Oniscoidea with six—besides two or three genera referred to as unknown to the author. Of the fourteen genera specified three are gen. nov.,

and of the eight in the first section four names have to be set aside as synonyms. One of these four is thus dealt with in the Additamenta. In the second section a subgenus of the first genus will have to be renamed if the rules of nomenclature be rigorously enforced.

None of the genera in the other families are new. The Ligiæ include four genera known to the author, besides two, or perhaps three, which are cited as unknown to him; the name of one of the four needs orthographic emendation. The Tylides and Syspastidæ contain one genus apiece; the name of the last genus will have to be sunk in favour of that which it was designed to supersede.

The number of species new to science that are described is 164 or 166, viz.:—of *Armadillo* 27, *Eubelum* 1, *Periscyphis* 2, *Cylloma* 1, *Armadillidium* 12, *Porcellio* 82 or 84, *Platyarthrus* 1, *Oniscus* 26 or 28, *Trichoniscus* 2, *Ligidium* 3, *Ligia* 3, and 4 of *Tylos*.

The following is an enumeration of the total number of the species of all of the genera, combined with synonymic notes:—

Family *Onisci*, Section *Armadilloidea*.—*Armadillo*, Duméril (1816) [*nec* Lat. (1804), *neque* Brisson (1756)], = *Cubaris*, Brandt (1833), enlarged Eaton (1882) [? = *Cubaris*, Billb. (1820)], 37 good species and 24 *sedis incertæ*. Mr. Budde-Lund has failed to restore to the first of the species the name assigned to it by Cuvier, and quotes the reference concerning it with hesitation at second hand from Latreille, who blundered unaccountably over Cuvier's unmistakable illustrations of this species. In the discussion of the nomenclature of this genus in Ann. & Mag. Nat. Hist. (1882) p. 361, the possibility of *Cubaris* being precluded from adoption as the name for this genus by its having been preoccupied in Crustacea (as indicated above) was not taken into account. The reviewer, writing at a distance from libraries, is obliged to leave undecided the question whether *Sphærillo* or *Orthonus*, enlarged in its application, may not have to take precedence over *Cubaris*. *Eubelum*, gen. nov., 1 sp.; *Pseudarmadillo*, De Sauss., 1 sp.; *Cercocytonus*, B.-L. = *Periscyphis*, Gerstäcker (1873) [misprinted by the author *Peryscyphis*, *passim*], 3 sp.; *Sphæroniscus*, Gerstäcker, 1 sp.; *Cylloma*, gen. nov., 1 sp.: this genus must be renamed in view of *Cyllomus*, Hal., and *Cyloma*, Sharp. *Eluma*, B.-L. = *Rhacodes*, Koch (1856), and *E. purpurascens*, B.-L. = *Rh. inscriptus*, Koch, the only species. Mr. Budde-Lund, misled by Ebner, quotes *Rhacodes* as a synonym of *Tylos Latreillii*; but its identity with *Eluma* is unquestionable, and therefore this last name must rank as a synonym. The name *Rhacodes* is not invalidated by *Rhacodia*, Hübn. (1816) or Schaeff. (1838). *Armadillidium*, Bdt. & Ratzeb., 31 good sp. and 11 *sedis incertæ*. The number 31 may possibly be open to reduction; some of the structural differences relied upon in the descriptions for the distinction of a few of the species appear to be very like differences dependent upon diversity in age of the individual specimens examined. No indication is afforded as to whether Mr. Budde-Lund's conclusions as to the validity of the species to which these remarks are appli-

cable were based upon observation of living examples, or merely upon the study of museum specimens.

Family *Onisci*, Section *Oniscoidea*.—The author divides into 7 the old genus *Porcellio*, Lat., and leaves it an open question whether the subdivisions should be accounted distinct genera or only subgenera. The subdivisions bear distinctive names and are treated as genera in the text, but are numbered as subgenera. 1st. *Cylisticus*, Schnitzler (1853), 7 sp. 2nd. *Porcellio*, Lat. (1803), restricted B.-L. (1879), 71 good species, 24 ill-characterized, 3 fossil, and 6 "catalogue species." The author ranks *Lucasius myrmecophilus*, Kinahan, amongst the seventy-one species; but the propriety of so dealing with it seems very questionable. His note as to its affinity to *Platyarthrus* might even be amplified. 3rd. *Hemilepistus*, B.-L. (1879), 10 sp., of which two are renamed. 4th. *Metoponorthus*, B.-L. (1879), 35-37 good species and 3-5 *sedis incertæ*. 5th. *Rhyscotus*, gen. nov., renamed, *vice Stenomacrus*, B.-L. MS. (1879), 1 sp. 6th. *Leptotrichus*, B.-L. (1879), 4 or 5 sp.: this name should be abandoned, being preoccupied in zoology, e. g. *Leptotriccus* [*sic*], Cab. Heine (1859), and *Leptothrix*, Menge (1868). 7th. *Bathytropa*, B.-L. MS. (1879), gen. nov., 2 good sp. and 1 nameless. *Platyarthrus*, Bdt., 2 or 3 sp. The author deals with the old genus *Oniscus* in the same manner as with *Porcellio*, dividing it into 5 named subgenera, which are treated as genera in the text. 1st. *Oniscus*, L., restricted, 5 or 6 good species and 13 reputed sp. Of these last *O. fossor*, Koch, is probably nothing but a condition of *O. murarius*, L.; *O. minutus*, Koch, is very nearly related to *Philoscia pulchella*; and the two species named by White should be referred to *Hemilepistus* and *Porcellio* (restrict.) respectively, doubtless to be reduced to synonymic insignificance. 2nd. *Philoscia*, Lat., 22 good species, 4 *sedis incertæ*. 3rd. *Alloniscus*, Dana, 8 or 9 sp. 4th. *Lyprobius*, gen. or subgen. nov., 3 sp. 5th. *Scyphax*, Dana, 3 sp. The author's transfer of *S. intermedius*, Miers, to the genus *Philoscia* is inadmissible. *Deto*, Guérin, 2 good species and 2 reputed species. Of the latter *D. Whitei*, Kinahan, probably=*echinata*, Guérin, and was founded upon specimens differing in sex from that figured by the last-mentioned author, because the number of segments armed with spines is larger in the male than in the female. [The reviewer states this from recollection.] *Armadilloniscus*, Uljanin, 4 sp. and 2 *sedis incertæ*. *Scleropactes*, gen. nov., 3 sp. Then two genera *sedis incertæ* are referred to:—*Acanthoniscus*, 1 sp., and *Ourachærus*, 1 sp., both named from White's MS. by Kinahan. The former is related to the genus *Armadillo* of this work.

Family *Ligiæ*.—*Trichoniscus* is divided into 2 subgenera which are named and dealt with as genera. 1st. *Trichoniscus*, Bdt., 8 sp., and 1 in amber. 2nd. *Haplophthalmus*, Schöbl, 2 sp. *Titanethes*, Schjödte [*Titanethus*], 1 sp. and 5 reputed sp. *Ligidium*, Bdt., 5 good sp. and 3 reputed sp. *Ligia*, Fab., 12 sp. known and 5 unknown to the author. *Styloniscus*, Dana, 3 sp. *Stymphalus*, B.-L. MS. (1879) gen. nov., 1 sp. *Euphiloscia*, Packard [1 sp. not cited].

Family *Tylidæ*.—*Tylos*, Lat., 12 sp. Family *Syspastidæ*.—*Syspastus*, B.-L. (1879), = *Helleria*, Ebner (1868), 1 sp. It has already been intimated that the name *Helleria* must be restored to this genus, Ebner having priority of publication over the other authors who have proposed the same name for different genera.

The total number of species described is 404 or 410, of which 312 or 316 are good species and 92 or 94 are species unknown to the author or reputed species. The total number of genera is 36 or (if some be accounted subgenera) 25.

MISCELLANEOUS.

Diagnoses of three new Oriental Mammals.
By OLDFIELD THOMAS, Natural History Museum.

1. *Herpestes auropunctatus birmanicus*, var. nov.

Essential characters of *H. auropunctatus*, but hair shorter, colour darker, and size markedly larger. Skull of type 62·7 millim. long and 34 broad, as compared with 59·0 and 30·0 millim. in the type of *H. auropunctatus*; head and body 392 millim.; tail 214; hind foot 55.

Hab. Pegu (*E. Oates*)—*type*. Burma (*R. G. Wardlaw Ramsay*); Dilkoosha, Cachar (*J. Inglis*); Manipur (*A. O. Hume*).

2. *Sciuropterus Davisoni*, sp. n.

Slaty grey above, tipped with orange, pale orange below. Tail brown above, deep orange-rufous below.

Allied to *S. lepidus*, Horsf., and *S. Pearsoni*, Gr., but distinguished from the first by its larger size, much larger and broader ears, and brighter coloration; from the second by its untufted ears; and from both by its differently shaped skull and by the absence in it of the small first upper premolar. Head and body 142 millim.; tail 172; hind foot 36.

Hab. Malacca (*W. Davison*).

3. *Mus Humei*, sp.

Externally similar in almost every respect to *Golunda Ellioti*, Gray, but with the ungrooved incisors and narrow molars of true *Mus*. Front edge of anterior zygoma-root concave, as in *Mastacomys fuscus*, Thos., and some other Australian Muridæ. Head and body 125 millim.; tail 106; hind foot 25·0.

Hab. Moirang, Manipur (*A. O. Hume*).

Figures and full descriptions of these new mammals will shortly be published in the 'Proceedings of the Zoological Society.'

An Endoparasite of Noteus. By Sara Gwendolen Foulke.

In classifying the Ciliata-Holotricha W. Saville Kent has created a special division for those members of the order which possess no distinct oral aperture, distinguishing them as the Holotricha-Astomata. This division includes but one family group—the Opalinidæ—comprising four genera:—*Opalina*, *Anoplophrya*, *Haptophrya*, and *Hoplitophrya*. The Opalinidæ are, without exception, endoparasitic in habit.

Of these four genera the characteristics may be summed up as follows:—*Opalina* and *Anoplophrya* are both free swimming, without means of attachment, and differ chiefly in the form of their endoplast; *Haptophrya* and *Hoplitophrya* are both furnished with means of attachment, the difference in form of which furnishes the generic distinction, the former possessing a sucking disk, the latter a corneous keel-like band or one or more hooks. *Opalina* proper is further separated by restricting its habitat to "the intestinal viscera of various tailed or tailless Amphibia."

A *Noteus*, species unknown, having been crushed in the live-box, there were expelled from the animal's body, with its fluids, ciliated bodies exhibiting decided movements. Scarcely more tangible in their colourless transparency than air-bubbles, these bodies, varying in shape from globose to ovate, were more or less uniformly clothed with long delicate cilia, whose rhythmical undulations produced but slight onward motion. No endoplasm was visible, and no opportunity for the use of reagents was afforded, as in about ten minutes the bodies became quiescent, and then rapidly disintegrated, the cilia disappearing first. Dr. Jos. Leidy recommends as a successful medium of preservation for such forms a little white of egg introduced into the water, which is not of itself sufficiently dense to support such delicate cell-walls.

One of the forms was gourd-shaped, the constriction being slightly above the middle, the whole appearance strongly suggesting lateral fission. Another, perfectly globose individual contained a number of the refractive germ-like bodies characteristic of the Protozoa, which, on being liberated by the dissolution of the parent cell, dispersed through the water, probably to seek a new host and complete the cycle of development. On the globular form the cilia appeared to be placed in bands or clusters, while those on the ovate form were more evenly distributed. It is possible that one may be merely an immature form of the other.

Simultaneously with these parasites a sac of protoplasm, measuring only $\frac{1}{1000}''$, and containing ten minute scarlet to dark red bodies, was expelled. It seemed to come from near the centre of the forward part of the body, but was not connected with the "eyes," as these remained intact. This sac remained motionless near the Rotifer for an hour, the scarlet bodies continuing in incessant motion during that time, but no change of any kind taking place. I have been unable to determine the nature of this sac or of the contained bodies, and should be glad of any information as to its probable character.

The parasites measured about $\frac{1}{800}''$, exclusive of the cilia, whose length more than equalled the diameter of the body. I believe them to have come from some one of those cavities of the Rotifer's body which are filled with clear rather thin fluid, perhaps from the stomach, but think it unlikely they can have come from the intestinal canal, because of their extreme fragility and of the very long investing cilia, making the total size too great for such confined quarters.

The characteristics above noted bring this form within the genus *Anoplophrya*, if we except the inconspicuousness of the endoplasm, supposing it present, but prevent its identification with any specific form therein included, that to which it most nearly approaches being *A. socialis*, described by Dr. Leidy, under the name of *Leucophrys socialis*, as present in the freshwater Polyzoon *Urnatella gracilis*. From *A. socialis* it differs, however, in point of size, being but one sixth that of the latter, in not having the cuticle striate, and in the superior length of its cilia.

I propose to name this new species *Anoplophrya Notei*.

Briefly stated the specific characteristics of this form are as follows:—Body globose or ovate, variably clothed with cilia more than equalling its length; endoplast undetected; contractile vesicle small; length $\frac{1}{8000}''$. *Hab.* Endoparasitic in *Noteus*.—*Amer. Journ. Sci.* Nov. 1885, p. 377.

On the Stellerida collected during the Expedition of the 'Talisman.' By M. E. Perrier.

The number of species of Stellerida collected during the expedition of the 'Talisman' amounts to fifty-four, represented by nearly two hundred specimens, some of which come from a depth exceeding 4000 metres. After the exploration of the great depths of the Caribbean Sea and the Gulf of Mexico by Alexander Agassiz, and the voyage of the 'Challenger,' it might be feared that a great number of the species dredged by the 'Talisman' would be already known. Even if this were the case its expedition would not have been unfruitful; it would have contributed to strengthen the idea of a supposed uniformity in the deep-sea fauna, and would have enriched our museums with specimens which we cannot hope to obtain by exchange. But we need not dread seeing the results of the voyage so ably organized by M. Alphonse Milne-Edwards reduced to these proportions. As yet we have found only three species of Stellerida common to the West Indian seas (*Dorigona arenata*, E. P.; *Goniopecten subtilis*, E. P.; and *Archaster* (*Cheiraster*) *mirabilis*, E. P.). The species identical with those of the 'Challenger' and of various English expeditions are the following:—*Brisinga coronata*, *Zoroaster fulgens*, and *Arcaster bifrons*. Of the species of Starfishes collected thirty-five are new, and many are eminently instructive by the combinations of characters they present.

A more complete examination of the forms of Brisingidæ which we have designated by the names of *Brisinga elegans*, *B. semicoronata*, and *B. robusta* has shown us in them in abundance those

tentacular tubes which are so constant in the Stellerida, but are deficient in the *Brisingæ* and *Freyellæ*; this is another transition towards the Asteriadæ, and it becomes necessary to establish for the three species which present this character a genus which we will name *Odinia*. Exactly between *Coronaster* and *Asterias tenuispina* we have to intercalate a new form of *Asterias* which we shall call *A. brisingoides*, and which is remarkable for having eight arms and for its crossed pedicellariæ, grouped, like those of *Coronaster*, at half the height of the spines. The genus *Zoroaster* has furnished, besides *Z. fulgens*, Wyv. Thoms., a new species, *Z. longicauda*, E. P., found at from 3000 to 4255 metres, which attains a diameter of 0·40 metre (16 inches), its disk being hardly 0·025 metre (1 inch), and the ambulacral tubes of which are quadriseriate only at the base of the arms. Near these Asteriadæ we have to place *Stichaster talismani*, E. P., which descends to a depth of 1442 metres; it presents seven rows of dorsal plates, and two rows of ventrals armed with small spines. *Zoroaster* and *Stichaster* form a family STICHASTERIDÆ, allied to the Asteriadæ, and apparently replacing that family at great depths.

A new *Cribrella* (*C. abyssicola*), having upon its adambulacral plates an oblique comb of five or six spines, alone, in our dredgings, represents the Echinasteridæ. On the other hand, the Goniasteridæ, Pterasteridæ, Porcellanasteridæ, and Archasteridæ are numerous. The Linckiadæ are entirely deficient beyond 200 metres, as well as the Pentacerotidæ, Asterinidæ, and Astropectinidæ. The new species of Goniasteridæ belong to three genera:—*Stephanaster*, with the arms dilated or rounded at the apex; *Pentagonaster*, of a pentagonal form, but with the sides concave and with pointed apices; and *Dorigona*, with elongated arms and with dorsal marginal plates meeting along the median line of the arms. *Stephanaster Bourgeti*, sp. nov., has only six marginal plates on each side of the body; those plates increase in size from the middle of the side to the penultimate inclusive. Analogous forms are found only on the shores of Australia and New Zealand (*Pentagonaster pulchellus*, Gray; *P. Dübeni*, Gray; *P. Gunnii*, E. P.; and *P. dilatatus*, E. P.). All the *Pentagonasteres* are uniformly granular, like *P. granularis* of the northern seas, and are distinguished by the number of their marginal plates, which are 10 (*P. Gosselini*, sp. n.), 12 (*P. crassus*), and 16–18 (*P. Deplasi*, *Vincenti*, *grandis*, sp. n.), and by that of their adambulacral spines, which are 3 (*P. Deplasi*), 4 (*P. Vincenti*), 5 (*P. crassus*, *P. Gosselini*), or more (*P. grandis*) on each plate. The *Dorigonæ* are represented by two species; they become shore-forms only in the seas of India and China.

The Porcellanasteridæ include no fewer than nine species distributed among the genera *Caulaster*, E. P.; *Porcellanaster*, W. T.; *Styracaster*, Sladen; *Hyphalaster*, Sladen; and *Pseudaster*, E. P. The *Caulasteres* (*C. pedunculosa*, E. P., and *C. Sladeni*, E. P.) are characterized by the almost complete absence of the dorsal skeleton, which is represented only by five fillets descending from the dorsal peduncle and exactly interradial. *Porcellanaster* (*P. inermis*, E. P., and *P. granulosus*, E. P.) has been well characterized by Percy

Sladen; but in opposition to his definition of the genus *Styracaster*, one of our species (*S. spinosus*, E. P.) presents a dorsal peduncle; the other (*S. Edwardsi*, E. P.) has only a simple tubercle, but each of its arms bears seven spines upon its median dorsal line. The *Hyphalasteres* (*H. Antonii*, E. P., and *H. Parfaiti*, E. P.) have their adambulacral plates of normal form and not oblique relatively to the furrow which they border; the former has seven cribriform organs, two of which are rudimentary, but there are for each arm nine dorsal marginal plates, of which the last four are soldered to their corresponding plates; the second has nine cribriform organs. The *Pseudasteres* exactly resemble *Pentagonasteres* with slightly concave sides; their cribriform organs are rudimentary and their apical plate is large and heart-shaped.

The nearest shore-relatives of the Porcellanasteridæ are the *Ctenodisci* of the North Atlantic and the coasts of Patagonia. They live at the following depths:—*Porcellanaster inermis* at 3000, *Styracaster Edwardsi* at 3655, *Hyphalaster Antonii* at 2995, *H. Parfaiti* at 4787, and *Pseudaster cordifer* at 4050 metres.

Among the Pterasteridæ we have to place a perfectly new form which we shall name *Myxaster sol*. All the Pterasteridæ hitherto known have short arms and a more or less pentagonal form. *Myxaster sol* has a broad flattened disk, round which radiate nine or ten slender, elongated, flexible arms, which give the animal somewhat the appearance of *Solaster endeca*. The dorsal marsupial sac so characteristic of the Pterasteridæ is, however, well developed and closed as usual by five valves. The two examples collected by the 'Talisman' were dredged off the coast of the Sahara, one at 1405, the other at 1550 metres. This form seems to us to indicate a much closer relationship than is usually admitted between *Solaster*, *Korethraster*, and the Pterasteridæ.—*Comptes Rendus*, Nov. 2, 1885, p. 884.

Reproduction of Freshwater Planariæ by Transverse Division.

With reference to a previous statement of his upon the above subject (see 'Annals,' December 1885, p. 522), Dr. Otto Zacharias calls attention to the fact that Dr. J. von Kennel had already noticed the occurrence of the phenomenon in the freshwater Planarians of Trinidad (Arb. zool.-zoot. Inst. Wurzb. Bd. vi. 1883). Dr. von Kennel says:—"All the freshwater Planariæ that I found are remarkable for their very small size, but one of them, from a small pond on the east coast of the island, also by an interesting biological peculiarity—it multiplies normally by *transverse division*, so far as I know the first certain example among the Dendrocœle Planarians. So far as could be ascertained from the living animal, no *sexual organs* are present, or they are in a very primitive state of development. A short distance behind the mouth eye-spots make their appearance as new formations, probably in connexion with the development of a new brain; also a new œsophagus with a buccal orifice; a slight depression of the epidermis indicates the future place of division, and I frequently saw the breaking into two individuals under the microscope."—*Zoologischer Anzeiger*, Nov. 23, 1885, no. 209, p. 666.

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X.—*Notes on some Earthworms from Ceylon and the Philippine Islands, including a Description of two new Species.* By FRANK E. BEDDARD, M.A., F.R.S.E., Prosector to the Zoological Society of London.

[Plate II.]

THE following notes refer to a number of earthworms which I have had the opportunity of dissecting during the past year. The specimens were in no case in any fit condition for histological examination, and the descriptions of the rough anatomy are in many points incomplete. I have thought, however, that the observations are worth publishing, because they relate in two cases to new species, one of which at any rate (*Perichæta ceylonica*) possesses certain structural features hitherto unknown in the genus to which it belongs.

Perichæta ceylonica, n. sp. (Pl. II. figs. 1–3.)

Several species of his genus *Perichæta* have been described by Schmarda * from the island of Ceylon; but in no case are these descriptions, although accompanied by chromo-lithographs, of much use, since they refer only to external characters, and even these are recorded in a very meagre fashion. It is therefore a matter of total impossibility to

* Neue wirbell. Thiere, Bd. ii.

decide whether the present species is really new to science or is identical with one of the four species recorded by Schmarda. I am not aware of any means of solving the difficulty, and therefore venture to describe the present species under a new name, indicating its habitat, since it clearly differs from any *Perichæta* whose anatomy is known and whose specific distinctness can on this account be determined with certainty.

I have only had the opportunity of examining a single specimen of the earthworm, which I owe to the kindness of Dr. Ondaatje.

The worm measures 9 inches in length by about 10 millim. in breadth; it is of an intense black colour on the dorsal surface, of a dark grey on the ventral surface. In the region of the clitellum the colour of the ventral surface differs, and is black, like that of the dorsal surface.

The *clitellum* is so far different from that of other *Perichætæ* that it is not sharply marked off from the rest of the integument either anteriorly or posteriorly; this may be due to the inferior state of preservation of the specimen, but is probably not so; other species of the genus that I have recently examined, although softened and injured by preservation in weak alcohol, still retain the characteristic distinctness of the clitellum, which in this genus is continued right round the body without a break and is not saddle-shaped, as in *Lumbricus* and many other genera. The clitellum of *Perichæta ceylonica* occupies segments 14, 15, 16, and a part of 17.

The *setæ*, as in the majority of species, form a continuous row round the middle of each segment; in the ventral median line, however, a minute median area remains devoid of setæ; it did not appear to me that there was anything characteristic in the shape of the setæ.

The apertures of the spermathecæ are conspicuous on the boundary-line between segments 8 and 9; they are widely separated from each other.

On the 18th segment are the male generative openings, which present an arrangement unlike that met with in any other species of the genus at present known. The row of setæ, which in all the other segments of the body is continuous or very nearly so round the middle of the segment, stops short of the middle line in the 18th segment, leaving a median space of 3·5 millim. in extent entirely devoid of setæ. On either side of this bare patch is a conspicuous orifice (fig. 1, *b*), through which protrude one or two peculiarly modified setæ generally known as "penial" setæ. On the left side of the body in the specimen before me there are two such setæ, on the right only one. The general shape of these setæ can be understood

by an inspection of fig. 3; the distal and proximal ends are slightly curved and convergent, while the middle portion is straight; the distal extremity of the seta which protrudes through the orifice ends in a sharp point and is furnished with a series of minutely serrated ridges which are at first regular, but as they approach the tip become broken up; fig. 3 *a*, which is a highly magnified representation of this portion of the seta, shows its characteristic form and is better than any description. It is only the distal one fourth of the seta which is thus ornamented; the ridges gradually disappear behind.

In front of the aperture through which protrude these penial setæ, and therefore close to the anterior limit of the segment, is another pair of apertures (fig. 1, *a*), approximately in the same straight line with the posterior orifices. The two apertures of each side of the body are situated upon a flattened area differing somewhat in its appearance from the rest of the integument. The internal structures corresponding to these apertures are peculiar: the anterior pair of orifices lead in each case into a long somewhat coiled tube, ending cæcally and of uniform diameter throughout (fig. 2, *a*); with each of the posterior pair of apertures is connected a large brown gland (fig. 2, *b*), divided by deep furrows into a multitude of minute lobules; this prostate gland opens to the exterior by a long somewhat curved muscular duct; on the left side of the body the gland extended through five segments, commencing with and including the eighteenth; on the posterior side of the duct of the prostate gland is a thin-walled sac (*c*) containing the penial setæ already referred to. I am unable to state the relations of the vasa deferentia to these two glands, since they, as well as the testes, could not be recognized.

With the exception of a single species described by myself * no *Perichæta* is known which possesses these peculiarly modified penial setæ; they are, however, characteristic of other genera (e. g. *Acanthodrilus*, *Eudrilus*, *Typhæus*), and present more or less the same form in all, differing widely from the ordinary setæ of the body.

The complication of the prostate glands in *Perichæta ceylonica* is a new feature in the organization of this or any other genus.

A multifid prostate gland, like the posterior gland of *P. ceylonica*, is characteristic of the genus *Perichæta* and is found in all species of the genus with but trifling modification in shape, depending upon the more or less complete lobulation of

* *P. armata*, Ann. & Mag. Nat. Hist. 1883, p. 216.

the gland. A simple tubular prostate is characteristic of the genera *Eudrilus*, *Pontodrilus*, and *Typhœus*, where it is either a straight uniform tube (*Eudrilus*) or curved. *Acanthodrilus* for the most part agrees with the last-named genera in the form of the prostate glands, but differs in so far that there are two pairs instead of only one. In some genera (*Lumbricus*, *Microchæta*) there are no prostate glands at all. *Perichæta ceylonica* therefore combines the characters of *Perichæta* and *Acanthodrilus*; it agrees with the former genus in the distribution of its setæ, while the generative organs approximate in many points to those of *Acanthodrilus*.

In *Acanthodrilus*, as already stated, there are two pairs of prostate glands, to each of which corresponds a bundle of penial setæ; the apertures of these glands are, in the majority of species, upon the 16th and 18th segment; there is usually a segment interposed between the two pairs of orifices. In one species, however, if I do not misinterpret M. Perrier's statements, there is a slight difference. In this species (*Acanthodrilus verticillatus*) the two pairs of orifices are more closely approximated, being situated upon the 17th and 18th segments. *Perichæta ceylonica* forms a third term in the series; there are four male generative apertures, but these are all upon the same segment (the 18th), one pair behind the other*. Finally we have, as in the vast majority of earthworms, a single pair of male generative apertures with or without prostate glands. It is interesting also to notice that the prostate glands of *P. ceylonica* combine characters that are found in different genera, but here united in the same species; one pair of prostate glands are typically "Perichætous;" the anterior pair are like those of *Pontodrilus* and other genera.

There is a single pair of copulatory pouches present which, as already observed, open to the exterior on the boundary-line between the 8th and 9th segments: the copulatory pouches are large in proportion to the size of the animal; each is furnished with a simple diverticulum, as in *P. post-*

* Perhaps the genus *Eudrilus* resembles *Perichæta ceylonica* in these respects. M. Perrier's description of the male generative organs in that genus are unfortunately not very complete, owing to the inferior state of preservation of the specimens at his disposal. In the description of the genus *Eudrilus* (Nouv. Arch. do Mus. t. viii. p. 74) he speaks of two different glandular (?) structures uniting together with the vas deferens to open to the exterior; the first of these is an elongated organ, which is compared to the prostate of other earthworms; the second is a Y-shaped tube which opens into the dilated distal extremity of the vas deferens separately from the former. These structures are stated to occur in *E. Lacazii*, *E peregrinus*, and *E. decipiens*.

huma (fig. 7). There appear to be no nephridia present, but the poor condition of the specimen does not permit me to speak with certainty.

The dorsal vessel is united with the ventral by several transverse trunks in the anterior part of the body; in segments 11, 12, and 13 are three large pairs of transverse trunks arising from the supra-intestinal vessel and uniting this with the supra-nervian; these correspond to the "cœurs intestinaux" of Perrier, who has described similar transverse vessels in *Urochæta* * and in *Pontodrilus* †.

Perichæta Houlleti, E. P.

Perichæta Houlleti, E. Perrier, Nouv. Arch. d. Mus. t. viii. p. 99.

This species has been recorded by M. Perrier from Calcutta and from Cochin China. Among a large number of earthworms from Manila which I owe to the kindness of my friend Mr. H. E. Barwell I observed a single specimen evidently referable to the same species. The peculiar form of the copulatory pouches, unlike that occurring in any other *Perichæta*, renders the identification of my specimen with the species described by M. Perrier a matter of certainty.

Perichæta posthuma. (Pl. II. fig. 7.)

Perichæta posthuma, Vaillant, Ann. Sci. Nat. 1868.
Perichæta affinis, E. Perrier, Nouv. Arch. d. Mus. t. viii. p. 106.
Megascolex affinis, F. E. Beddard, Ann. & Mag. Nat. Hist.

Dr. Horst has called attention ‡ to the identity that really exists between Vaillant's species *Perichæta posthuma* and *P. affinis* of Perrier; if his identification be correct, it is obviously necessary to cancel the name *P. affinis*.

A large number of examples of a small species of *Perichæta* from the neighbourhood of Manila evidently belong to this species; they present at any rate the following points of agreement with the description as given by Perrier:—The male generative apertures, situated on the 18th segment (the second behind the clitellum), are preceded and succeeded by a pair of genital papillæ on the adjoining segments; the copulatory pouches are situated in segments 6, 7, 8, 9; each consists of an oval sac with a small tubular diverticulum; the two last pairs of copulatory pouches are situated in the segment which contains the gizzard; it is evident therefore that this segment, though not divided by a mesentery, is composed of two fused segments. Testes in segments 11 and 12; a

* Arch. de Zool. Exp. t. iii. † *Ibid.* t. ix.
‡ 'Notes from the Leyden Museum,' vol. v.

vast number of œsophageal glands in segments 6 and 7 evidently metamorphosed nephridia.

The above facts are sufficient to show that I am right in identifying this species with *Perichæta posthuma* or at least with *P. affinis*. The point that I wish to call attention to, however, is the variability in number and in position of the copulatory pouches, and this is a matter of some little importance from the point of view of the determination of species.

In the majority of specimens there were four pairs of copulatory pouches with the distribution already recorded. Another specimen fully mature had only three pairs, while in a second equally mature there were four pairs, but the left-hand pouch of the seventh segment was extremely small and rudimentary. A third example, with well-developed clitellum and testes, had no trace whatever (visible to the naked eye) of copulatory pouches. These facts show that the copulatory pouches are not necessarily developed *pari passu* with the testes and clitellum; the absence of these structures in *Titanus* is possibly therefore only apparent

The most remarkable variation in the copulatory pouches that I have observed in this species is illustrated in fig. 7; in this example there were three copulatory pouches present, situated in a row on the right hand side of the nerve cord in the eighth segment.

Moniligaster Barwelli, n. sp. (Pl. II. figs. 4–6.)

I owe to the kindness of my friend Mr. H. E. Barwell, who is at present resident in Manila, a number of examples of a small earthworm from the neighbourhood of that town which appear to belong to Perrier's genus *Moniligaster*.

Moniligaster is at present only known by one species (*M. Deshayesi* *), a native of Ceylon, which is characterized by the apparent absence of a clitellum and by the very remarkable disposition of the œsophagus; instead of being furnished with but a single gizzard, as in the majority of earthworms, or with two, as in *Digaster*, the œsophagus of *Moniligaster* has five distinct gizzards, one situated in the sixth ring of the body and separated by an interval from four other separate gizzards, which are in close connexion with each other and pass immediately into the intestine.

Moniligaster Barwelli is a small earthworm not more than 1½ inch in length, judging at least from some twenty examples which I have had the opportunity of examining; the other

* Nouv. Arch. d. Mus. t. viii. p. 130.

species, according to Perrier, is 150 millim. or 6 inches in length.

The body of the worm is somewhat flattened from above downwards, and is of a greenish colour and very translucent, so much so that even in the alcohol-preserved specimens the nervous system, the ventral blood-vessel, and in places the segmental organs were quite visible from the outside.

I was unable to discover any traces of a clitellum, and inasmuch as the generative organs appeared to be well developed, the absence of this structure can hardly be accounted for by presuming the specimens to be immature. It is at least a curious fact that not a single one of twenty specimens had any trace of clitellum; it would be obviously hasty to insist upon the absence of a clitellum so generally found in earthworms until there is some more definite proof; but, as already stated, Perrier was unable to find any clitellum in a single example of *M. Deshayesi* examined by him, and the coincidence is remarkable.

The only apertures that I could detect upon the surface of the body besides the mouth and anus were two oval slit-like orifices with tumid yellowish lips, which are the male generative orifices, and are situated between segments 9 and 10 between the ventral and dorsal pairs of setæ. The setæ are disposed precisely as in *M. Deshayesi*, viz. in four series of pairs; the setæ of each pair are very closely approximated. In the disposition of the œsophagus this new species agrees in the main with *M. Deshayesi*; in one specimen at any rate there were four oval nacreous-looking dilatations of the œsophagus close to its junction with the intestine; the anterior gizzard of *M. Deshayesi* of the sixth segment appears to be absent in this specimen.

There are well-developed nephridia in all the segments of the body.

Generative Organs.—The *ovaries* and their ducts I have been entirely unable to discover.

The *testes* are present to the number of a single pair of large oval compact glands, situated in the 9th segment. The relation of the vas deferens to the testes will be apparent from the accompanying figure (fig. 4); it is a thin, delicate, much coiled tube which expands when it reaches the testis and appears to become continuous with its covering. I did not succeed in detecting any funnel-like expansion separate from the testis. The vas deferens (*v.d.*) passes down towards the ventral side of the segment, and its termination on the boundary line between the 9th and 10th segments is furnished with a small oval gland (*p*) which corresponds to the prostate gland of other

Oligochæta. A portion of the vas deferens highly magnified is shown in fig. 6; it consists of a single layer of ciliated cuboid cells, each containing a large nucleus; in structure it is precisely similar to that of other earthworms. I have figured a portion to show that there has been no mistake on my part in the identification of the vas deferens, which differs in several points from the vas deferens of other earthworms. These differences consist mainly in the fact that it lies chiefly in the same segment as the testis, opening between this segment and the next, and that there is only a single vas deferens on either side of the body. The figure to which I have referred illustrates this point; it represents the testicular segment seen from behind: T is the large oval testis, *v.d.* the coiled vas deferens, and *p* the prostate, in common with which the vas deferens opens; *œ* is the œsophagus seen in section; D and *y*, the dorsal and ventral blood-vessels respectively; the transverse trunk or heart (*v.s.*) which unites the two gives off a large vessel which presently divides into two branches, one passing up to the testis, the other supplying the prostate.

Evidently therefore this earthworm, in the structure of the male generative organs, assimilates very closely to the type of structure characteristic of, though not always found in, the Limicolous Oligochæta. Where there is but a single vas deferens on either side of the body, as in the Naidomorpha, Chætogastridæ, Tubificidæ, and Enchytræidæ, its external aperture is situated in the segment following that which contains the testes, so that the vasa deferentia like the nephridia traverse two segments, the internal funnel being situated in one and the external orifice in the next.

In the example of *Moniligaster Barwelli* described above the vas deferens is confined apparently to one segment; but in other specimens the testes themselves lie in two segments (8 and 9), projecting through the mesentery, so that the internal funnel of the vas deferens, which is represented by the outer tunic of the testis, in reality does traverse two segments. Furthermore there is an agreement with many of the Limicolæ in the forward position of the testes and male generative opening. In earthworms there are invariably two pairs of vasa deferentia, which may (*Urochæta*) or may not (*Acanthodrilus*) become fused posteriorly into a single tube on either side, and they traverse several segments (sometimes as many as six) on their way to the exterior. There is evidently a great difference from the disposition of the male organs of *Moniligaster Deshayesi*. In *Moniligaster Deshayesi* the male generative organs have a disposition which is, so far as is

known at present, unique among the Oligochæta. There are two pairs of testes in the 8th and 10th segments respectively; each of these opens on to the exterior by a separate vas deferens furnished at its termination with a prostate gland; the anterior pair of apertures are placed in the 7th segment in front of the testes belonging to them, the latter between the 10th and 11th segments behind their testes. This latter pair of apertures correspond exactly to those which I have found in *M. Barwelli*. The anterior pair of testes together with the accessory structures were entirely absent; but in this segment were a pair of copulatory pouches (fig. 5) opening on to the exterior in front of the outermost pair of setæ. The copulatory pouches are remarkable from the fact that the pouch itself is a small spherical vesicle communicating with the exterior by a long, slender, variously coiled and contorted duct, which, together with the pouch, is closely applied to the mesentery dividing the segment from the one in front. The length of the duct is remarkable and recalls the copulatory pouch of certain Limicolous Oligochæta (e. g. *Anachæta Eiseni*, Vejdovsky, *loc. cit.* pl. vii. fig. 22). The presence of a pair of copulatory pouches, instead of an anterior pair of testes and vasa deferentia, brings the structure of the genital apparatus in this species much nearer to the usual condition met with in earthworms. M. Perrier's account of the male genital apparatus of *M. Deshayesi*, which is illustrated, is too circumstantial to admit of any doubts of its accuracy, though there is evidently some resemblance between the vas deferens ("entortillée comme serait un Gordius") of *M. Deshayesi* and the convoluted duct of the copulatory pouch in the present species.

I feel uncertain therefore whether there is a real difference between the two species in the structure of the male genital organs, or whether the anterior testes and their ducts may not, as M. Perrier suggests, be developed at different times; at the same time it seems hardly likely that the vasa deferentia and prostates would disappear with the testes, and I am certain that a second pair of these structures did not exist in the specimens of *M. Barwelli* which I have examined. Moreover, a comparison of M. Perrier's figures of the posterior testes with their ducts and accessory structures* with my own (fig. 4) will show that there is sufficient difference to separate the two forms, at least specifically, without reference to the presence or absence in *M. Barwelli* of the anterior testes.

* *Loc. cit.* pl. iv. figs. 79 and 81.

EXPLANATION OF PLATE II.

Fig. 1. *Perichæta ceylonica.* Clitellum and neighbouring segments: *a* and *b*, openings of glands lettered *a* and *b* in fig. 2.
Fig. 2. Prostate glands of same: *a*, coiled tubular gland; *b*, multilobate gland.
Fig. 3. Genital seta of same.
Fig. 3 *a*. Distal extremity of genital seta.
Fig. 4. Diagrammatic transverse section of segment 9 of *Moniligaster Barwelli.* *æ*, alimentary canal; *D*, dorsal blood-vessel; *y*, ventral blood-vessel; *n*, nerve-cord; T, testis; *v.d.*, vas deferens; *p*, prostate; *v.s.*, lateral blood-vessel connecting dorsal and ventral blood-vessels; *s*, ventral pair of setæ; *s'*, dorsal pair of setæ.
Fig. 5. *C.p.*, copulatory pouch of same; *n*, nerve-cord; *s*, ventral pair of setæ; *s'*, dorsal pair of setæ.
Fig. 6. Portion of vas deferens of same (*v.d.* in fig. 4), highly magnified.
Fig. 7. Copulatory pouch of an example of *Perichæta posthuma*; three pouches in one segment (no. 8).

XI.—*Some new Infusoria from American Fresh Waters.*— No. 2. By Dr. ALFRED C. STOKES.

[Plate I.]

Heteromita variabilis, sp. nov. (Pl. I. fig. 1.)

Body soft, flexible, and very changeable in shape, subspherical, ovate, elongate, subcylindrical, frequently with both extremities curved towards the ventral aspect, and often with the anterior border slightly and obliquely emarginate; endoplasm granular; flagella very unequal in length, the trailing appendage twice as long as the contracted body, the vibratile one third or one fourth of the length of the body; contractile vesicle single, spherical, located near the centre of the ventral surface; nucleus single, subspherical, near the posterior extremity. Length of body $\frac{1}{2250}$ to $\frac{1}{1125}$ inch.

Hab. The apparently empty body of a dead *Canthocamptus minutus*, Müller.

Fig. 1 shows some of the changes in form assumed by this remarkably metabolic creature, of which the posterior extremity is especially soft and changeable in shape. The infusorian differs from all other members of its genus in the proportionate length of the flagella, the vibratile appendage being shorter than that of any previously recorded species. The animalcules were observed crowding the empty body of a dead *Canthocamptus.*

Paramonas alata, sp. nov. (Pl. I. fig. 2. Diagram.)

Body ovate, persistent in form, about twice as long as broad, widest and rounded posteriorly; traversed longitudinally

by four compressed, equidistant, somewhat obliquely directed keel-like elevations, thus exhibiting in horizontal optic section four diverging wing-like appendages or processes; oral aperture conspicuous; flagellum about twice as long as the body; endoplasm transparent, colourless. Length of body $\frac{1}{1125}$ inch.

Hab. Pond-water, with *Ceratophyllum demersum*, L.

In fig. 2 is delineated a diagrammatic horizontal optic section, showing the arrangement of the alæ.

Clostenema*, gen. nov.

Animalcules naked, free-swimming, fusiform or elongate, persistent in shape; flagella two, diverse in length, originating near together at the anterior border, the longer extended in advance, the shorter usually held beneath the lower surface, both vibratile; pharyngeal passage present, and apparently communicating with the contractile vesicle.

Clostenema socialis, sp. nov. (Pl. I. fig. 3.)

Body fusiform, three times as long as broad, the frontal border obliquely emarginate, the posterior extended in a short rounded prolongation; long flagellum equalling or exceeding the body in length, the short one about one fourth or one fifth the length of the infusorian; pharyngeal passage extremely narrow; contractile vesicle double, in the anterior body-half, near one lateral border; nucleus apparently subcentral; endoplasm colourless, slightly granular. Length of body $\frac{1}{1500}$ inch. Anal aperture not observed.

Hab. Standing water, with *Lemna*. Gregarious.

Reproduction takes place by longitudinal fission, presumably after conjugation, which was observed. While swimming the animalcules advance evenly and rather slowly without revolution on their axis, the long flagellum being held in advance, the distal extremity most actively vibrating. The favourite position seems to be a quiescent one in companies, with the frontal border in contact with a mass of débris, or an algal filament, the flagella vibrating and extending quickly in various directions. No oral aperture could be positively discerned, although what I have interpreted as a very narrow pharyngeal passage was apparent. The granules within the endoplasm have a tendency to collect in the posterior prolongation, as if an anal aperture might be present there, but none has yet been noticed. The entrance of solid food-particles through the pharynx also escaped prolonged observation.

Its systematic position is probably among the Spheno-

* *κλωστής*, a spindle; *νῆμα*, a thread.

monadidæ of Saville Kent, immediately preceding *Sphenomonas*, from which it is excluded by its smoothly rounded surface and the position of the short flagellum, which, although vibratile, is more or less trailing, and habitually held beneath the body. Several individual animalcules have been observed with a bulbous enlargement to the distal extremity of the long flagellum.

CYCLANURA*, gen. nov.

Animalcules free-swimming, persistent in shape, compressed, the posterior extremity evenly rounded, and never exhibiting a caudal prolongation; otherwise as in *Phacus*.

This Infusorian, which is *Phacus* without the caudal prolongation, bears the same relationship to that genus as *Euglena* to *Amblyophis*.

Cyclanura orbiculata, sp. nov. (Pl. I. fig. 4.)

Body ovate or suborbicular, thick, compressed, scarcely longer than broad, having an excentric, longitudinal, keel-like elevation across the right-hand side; frontal border conspicuously emarginate; cuticular surface longitudinally striate; colour grass-green; endoplasm enclosing a spherical, posteriorly located amylaceous corpuscle; contractile vesicle anteriorly placed, in close proximity with the red pigment spot. Length of body $\frac{1}{560}$ inch.

Hab. Stagnant pond-water.

This rather peculiar form would seem to be foreshadowed by *Phacus acuminatus*, Stokes †, in which it is only necessary to suppress the short, straight, and sharply-pointed caudal prolongation, to have essentially the infusorian here described. The latter is, however, nearly twice as large as *Ph. acuminatus*, and its body is very much thicker and stouter. It is, indeed, more robust in every particular than any previously recorded species of the genus. This peculiarity is conspicuously apparent.

Chrysopyxis urceolata, sp. nov. (Pl. I. fig. 5.)

Lorica urceolate, less than twice as long as broad, widest anteriorly, tapering posteriorly to an obtusely rounded point of attachment, the margins then convex; or with nearly straight lateral borders and an acute point of attachment; narrowed anteriorly and prolonged as a short, truncate, necklike portion with slightly converging margins; animalcule subspheroidal, occupying the centre of the lorica, to which it is in

* κυκλάς, round; α, privative; οὐρά, tail.

† 'American Monthly Microscopical Journal,' Oct. 1885.

no way attached; flagella projecting considerably beyond the lorica mouth, widely diverging; colour bands yellow, laterally placed; contractile vesicle single or double, minute, posteriorly located. Length of lorica $\frac{1}{2250}$ inch.

Hab. Freshwater, attached to filamentous Algæ. Gregarious.

Chrysopyxis dispar, sp. nov. (Pl. I. fig. 6 and 6 *a*.)

Lorica urceolate, once and a half to twice as long as broad, widest anteriorly, tapering posteriorly to a subacute point of attachment, the lateral borders then nearly straight; or the body of the lorica subspherical, tapering, and constricted posteriorly; both forms narrowed anteriorly to produce a straight, more or less conspicuous neck-like prolongation; a curved partition extending transversely across the lorica near the centre, and dividing its cavity into two unequal parts; animalcule subspheroidal, not attached to the lorica, but supported by the transverse partition; colour bands yellow, lateral. Length of lorica $\frac{1}{1800}$ to $\frac{1}{1500}$ inch.

Hab. Freshwater, on confervoid Algæ, in company with the preceding.

Urotricha platystoma, sp. nov. (Pl. I. fig. 7.)

Body oval or somewhat obovate, less than twice as long as broad, subcylindrical, entirely ciliate, the cilia vibrating irregularly and independently, shortest and least numerous on the posterior border; cuticular surface conspicuously ornamented by minute hemispherical elevations arranged in longitudinal series; oral aperture apical, the margins slightly protruding, giving it a pouting aspect; posterior springing hair shorter than the body, obliquely directed, its distal extremity usually curved; contractile vesicle single, spherical, near the lateral border of the posterior extremity; anal aperture postero-terminal near the pulsating vacuole Length of body $\frac{1}{860}$ inch.

Hab. Standing water, with *Sphagnum*; movements rotatory and leaping by means of the posterior seta. Reproduction by transverse fission.

The oral aperture is enormously expansile. An individual has been seen attempting to engulf the empty lorica of *Trachelomonas volvocina*, Ehr., expanding the oral orifice to an extent nearly equalling the diameter of the spherical shell. The position of the anal aperture has not been previously observed in the species of this genus.

Tillina campyla, sp. nov. (Pl. I. fig. 8.)

Body elongate-ovate, entirely ciliate, soft, flexible, about three times as long as broad, widest and rounded posteriorly,

the anterior extremity recurved towards the ventral surface, the ovate oral aperture placed in the ventral concavity thus formed; cuticular surface longitudinally striate; pharynx short, recurved, the roof bearing a series of fine cilia, longest anteriorly, and projecting beyond the oral aperture; contractile vesicle single, spherical, posteriorly placed near the ventral surface; nucleus single, subspherical, and subcentral. Length of body $\frac{1}{180}$ inch.

Hab. Standing water, with dead leaves. Movements rapid.

The pharyngeal ciliation seems to be confined to the superior wall or roof. The cilia are very fine, and usually vibrate synchronously, thus presenting so close a resemblance to an undulating membrane, that their character can be satisfactorily determined only when the infusorian is in a dying condition.

Amphileptus monilatus, sp. nov. (Pl. I. fig. 9.)

Body elongate, subfusiform, about fifteen times as long as broad, the dorsal surface flattened, the ventral convex, the anterior trunk-like portion forming one fourth of the entire length of the body; the posterior attenuate tail-like part about one sixth of that length, the trunk bearing a fringe of larger cilia on its lower surface, and an even inferior row of trichocysts; contractile vesicles small, numerous, in a single series along the dorsal border, but not extending into the posterior attenuation; nucleus moniliform, the nodules small, ovate; pharnyx conical, finely plicate; anal aperture at the base of the caudal prolongation. Length of body $\frac{1}{35}$ inch.

Hab. Still water, with *Ceratophyllum* and *Utricularia.*

In general appearance this Infusorian closely resembles *A. gigas*, C. & L., differing chiefly in the shorter trunk, and especially in the moniliform nucleus, the latter, in *A. gigas*, being band-like.

In connexion with *A. gigas* I have been able to verify the statement of Wrzesniowski, that reproduction takes place by oblique central fission. The first noticeable change in the appearance of the body is the development of an obliquely directed subcentral ridge apparently surrounding the animalcule. The division is rapid, the anterior portion of the posterior moiety being very obliquely truncate and finally developing into the trunk; the posterior surface of the anterior part being evenly rounded immediately after fission. The oral aperture and conical pharynx are formed in the posteriorly separating moiety before the final division of the two individuals. Conjugation has been observed with a form which I have identified

doubtfully with *A. margaritifer*, Ehr., union taking place between the parts anterior to the oral aperture, this orifice being occasionally included.

Loxophyllum vorax, sp. nov. (Pl. I. fig. 10.)

Body elongate lanceolate, three times as long as broad, longitudinally striate, soft, flexible, and elastic, both extremities rounded and somewhat curved towards the ventral border, the posterior widest, the body tapering thence towards the frontal region; oral aperture subterminal, enormously expansile; dorsal border convex, the ventral usually flattened; nucleus single, ovate, subcentral; contractile vesicle single, spherical, situated near the ventral border of the posterior extremity; trichocysts numerous, conspicuous, arranged in a parallel series perpendicular to the frontal, dorsal, and posterior borders; anal aperture not observed. Length of extended body $\frac{1}{150}$ inch.

Hab. Standing water, with *Sphagnum*.

In a single instance the transparent colourless body was wonderfully distorted by the internal pressure of two *Rotifers* which the Infusorian had engulphed. The body was here scarcely longer than broad, and the surface was most irregularly protruded. As digestion was accomplished the normal contour was resumed, and the animal's sluggish movements became more active. When swimming the movements are often rotatory on the long axis.

Colpidium putrinum, sp. nov. (Pl. I. fig. 11.)

Body ovate, less than twice as long as broad, longitudinally striate, the anterior extremity obtusely pointed, the ventral surface slightly flattened; vibratile membrane small; contractile vesicle single, spherical, laterally located near the posterior extremity; nucleus subspherical, subcentrally placed; endoplasm granular, usually crowded with small spherical food-masses; anal aperture inferiorly postero-terminal. Length of body $\frac{1}{350}$ to $\frac{1}{850}$ inch.

Hab. A putrid vegetable infusion in creek-water.

Reproduction is by transverse fission, a second contractile vesicle generally appearing previous to the beginning of the process.

Colpidium striatum, sp. nov. (Pl. I. fig. 12.)

Body subreniform, twice as long as broad, longitudinally striate, the anterior extremity slightly curved towards the ventral aspect; vibratile membrane conspicuous; contractile

vesicle single, spherical, postero-lateral, often leaving several small vacuoles after systole; nucleus single, subcentral. Length of body $\frac{1}{560}$ inch.

Hab. An infusion of decaying aquatic vegetation.

In form this resembles *C. cucullus* (Schrank), S. K., being somewhat more curved anteriorly. It differs in having but one nucleus, and in the postero-lateral position of the pulsating vacuole. Reproduction is by transverse fission.

DIPLOMASTAX, gen. nov.

Animalcules free-swimming, holotrichous, elongate-ovate, subcylindrical, produced posteriorly in a more or less retractile tail-like prolongation; oral aperture ventral, enclosing two vibratile membranes; contractile vesicle single; trichocysts absent.

The proper position of the genus is probably with the Ophryoglenidæ of Kent, although the presence of two vibratile membranes will necessitate a slight change in the diagnosis of the family as now formulated.

Diplomastax frontata, sp. nov. (Pl. I. figs. 13 and 14.)

Body elongate-obovate, subcylindrical, transparent, longitudinally striate, and finely reticulated, five times as long as broad, the lower or ventral surface convex, the dorsal slightly concave, tapering posteriorly to a somewhat retractile tail-like prolongation forming about one fifth of the entire body; anterior extremity narrowed, obtusely pointed; oral aperture narrow, ovate, obliquely placed on the ventral or convex surface at some distance from the anterior extremity, enclosing two small vibratile membranes; contractile vesicle single, spherical, near the centre of the dorsal or concave border; nucleus presumably represented by a large, ovate, subcentral, clear space. Length of body $\frac{1}{180}$ inch.

Hab. Still water, with *Myriophyllum.*

The aspect of this interesting Infusorian floating on the concave or dorsal surface, with the obliquely placed oral aperture thus directed upwards, at once suggests the thought of a microscopic shark—the suggestion and the resemblance not being far-fetched. It is the appearance, however, that brings the shark to mind.

Reproduction is accomplished by transverse fission, presumably after conjugation, which I have observed, union being made at the anterior portions of the ventral surfaces. When fission is about to take place that part of the body in advance

of the oral aperture elongates, an opening, which finally becomes the mouth of the anterior moiety, forming at or near the frontal border and developing from each side a very conspicuous vibratile membrane, the one on the right-hand margin usually being the larger. The frontal cilia are then also more conspicuous and apparently larger than in the mature individual. The dividing portion finally separates, having the posterior tail-like prolongation and a terminal oral aperture containing the two prominent membranes, leaving the posterior or original animalcule apparently unchanged. The separated moiety, which at first but remotely resembles the mature animalcule, remains sluggish for some time. The large, projecting, flap-like membranes on the frontal border seem to be an incumbrance, and, until the oral aperture assumes its proper position and the membranes become enclosed, the Infusorian seldom moves unless jostled by some more active inhabitant of the live-slide, when it quickly darts forward only to resume its quiet waiting. The existence of the two vibratile flaps might readily have been overlooked, or the two mistaken for a single one, if reproductive fission had not been observed, since to separate them, even with a high-power objective, is no easy matter.

HISTIOBALANTIUM*, gen. nov.

Animalcules free-swimming, heterotrichous, ovate, somewhat depressed, persistent in shape, the ventral aspect flattened; setose hairs abundantly developed on all parts of the surface; the oral fossa near the centre of the ventral aspect, on the left-hand side of the median line, ovate, capacious, the cilia of the left-hand border long, fine, setose, the frontal wall bearing a ciliary tuft, and the right-hand margin supporting an undulating membrane, which forms posteriorly a freely motile infundibuliform sack continued backward as a narrow membranous tubular passage, at the posterior extremity of which is the oral aperture, the oral fossa also enclosing anteriorly a secondary vibratile tuft of long cilia; contractile vesicle multiple; nucleus ovate, anteriorly situated.

Inhabiting fresh waters.

This Infusorian is excluded from the Bursariadæ of Stein by the presence of the vibratile membrane, to say nothing of the remarkable infundibuliform sack with the tubular posterior prolongation and the anterior ciliary tufts. The adoral cilia fringing the left-hand border of the oral fossa apparently do not surround the posterior margin of the peristomial depres-

* ἱστίον, a membrane; βαλάντιον, a little sack.

sion, but are there met by the cilia of the right-hand margin, which do not conspicuously differ from those clothing the cuticular surface. From the remaining families of the order this Infusorian is excluded by the linear arrangement of cilia just referred to; the formation of a new family group will therefore be necessary for its reception, the position of the new group in a system of classification being immediately following Stein's Bursariadæ and preceding the Spirostomidæ of Kent, Histiobalantiidæ necessarily being the family title.

Histiobalantium agile, sp. nov.
(Pl. I. figs. 15 and 16.)

Body ovate, one and a half times as long as broad, somewhat depressed, the dorsal surface convex, the ventral slightly flattened, both extremities evenly rounded; the left-hand body-margin evenly convex, the right-hand border gibbous; cuticular cilia abundant, curved; numerous long, fine, setose hairs projecting from all parts of the surface; oral fossa ovate, capacious, situated near the centre of the right-hand side of the ventral aspect, its posterior region supporting a conspicuous retractile and freely motile infundibuliform membranous sack, which is posteriorly prolonged as a narrow, flexible, membranous, and tubular passage leading to the oral aperture, and anteriorly continued as a broad undulating membrane attached to the right-hand border of the oral fossa, and as an inconspicuous membranous velum adherent to the left-hand side of the same depression and enclosed within it; adoral cilia on the left-hand margin of the oral depression long, fine, setose; a broad tuft of long setose cilia springing from the frontal border of the oral fossa and directed backward, a second broad tuft of vibratile setose cilia anteriorly enclosed within the oral cavity, attached to the anterior superior wall, their posterior extremities free; oral aperture near the posterior extremity of the body, followed by a short somewhat adcurved pharyngeal passage; contractile vesicles small, multiple, scattered; nucleus ovate, situated near the anterior border; anal aperture not observed; endoplasm granular, colourless, transparent. Length of body $\frac{1}{375}$ inch.

Hab. Fresh water, with *Ceratophyllum*.

The enclosed adoral sack and its posterior tubular prolongation appear to be adherent to the walls of the oral fossa only at the points where the tubular passage surrounds the oral aperture, and anteriorly by the membranous continuation of the infundibulum. The entire organ, composed of bag-like velum and tubular adoral passage, is freely motile, being variously protruded and retracted and rolled from side to side,

the thin anterior right-hand membrane being at times thrust into the oral fossa or arched above it like a protecting shield. The enclosed superior vibratile tuft of cilia which, so far as I have observed, never protrudes beyond the margin of the oral fossa, is, when not in motion, usually pressed upward against the roof of the cavity, and when the Infusorian is viewed in a lateral position, or in vertical optic section, appears like the thickened edge of a vibratile membrane; it is only when the animalcule is examined by focussing through the thickness of the body from the dorsal surface, or when the creature fortunately comes to rest with the ventral aspect towards the observer, that the true character of the organ can be ascertained. The cluster widens posteriorly by a separation of its constituent cilia, as also does the lower and more nearly external frontal tuft. The latter, however, seldom or never vibrates. Its function appears to be to assist in imprisoning the food by closing down over the cavity, or by entering the latter in company with the undulating membrane.

The setose hairs extending beyond the cuticular cilia are about twice their length. They are evidently tactile in function, being used to inform the Infusorian of the approach of food or of an enemy to be avoided. If the former, the animalcule immediately and most actively leaps upon it, seizing and forcing it into the endoplasm so quickly that, although I have repeatedly witnessed the act, I am ignorant of the precise method employed in the capture. If an approaching free-swimming animalcule ever so slightly touches a setose hair on any part of the surface, *Histiobalantium* at once leaps upon it, frequently making a half-revolution on the transverse axis, and seldom missing the object wished for. The undulating membrane closes over the oral depression, often forcing itself within the cavity; the Infusorian makes a strong contractile, somewhat convulsive effort, at once reminding the observer of the similar movement by *Floscularia ornata* when food is passing onward towards the mastax, and the captive is dashed through the oral aperture into the posterior part of the body, whence it is gradually transferred to the anterior and dorsal regions for digestion. The whole act is performed with remarkable swiftness, the food being accompanied by an unusually large bubble of water, as if the oral fossa had poured its entire liquid contents into the endoplasm. This habit probably accounts for the development of the multiple contractile vesicles. The peculiar springing movements described are, it is supposed, caused by the sudden action of the setose hairs so abundant on the body.

The entire oral apparatus is remarkably complex. I may

therefore have misinterpreted some of the appearances. My drawings are, I fear, little more than diagrams.

Rhabdostyla pusilla, sp. nov. (Pl. I. fig. 17.)

Body campanulate, tapering posteriorly, less than twice as long as broad; cuticular surface transversely striate; peristomial border revolute, slightly exceeding the body-centre in width; pedicle scarcely longer than the body; contracted animalcule ovate. Length of body $\frac{1}{1125}$ inch.

Hab. Pond water, on *Ceratophyllum*.

Thus far but three individuals of this readily recognizable form have been met with, all of these being attached near together on a fragment of *Ceratophyllum*. It is the smallest member of the genus yet observed, and could easily be identified by its diminutive proportions alone. Each of the three specimens noted had the pedicle attached as shown in the figure, the extremity being adherent to the side of the plant opposite to that on which the Infusorian habitually expanded itself, the lower portion therefore curving around the basis of support and apparently acting as a spring whereby the contracted animalcule was suddenly and rapidly thrown to that side of the plant to which the pedicle was attached, the body of the animalcule then, as well as on its return to the former position, describing a semicircular path through the water. That this is, as I believe, characteristic of the species can be determined only by examining a larger number than has yet been obtained.

Vorticella Lemnæ, sp. nov. (Pl. I. fig. 18.)

Body conical-campanulate or subpyriform, not changeable in shape, less than twice as long as broad, widest centrally, the posterior extremity tapering; cuticular surface finely striate transversely; peristomial border revolute, not everted, slightly narrower than the body-centre; pedicle from two to three times as long as the body; pharyngeal passage long; contractile vesicle close to the vestibulum. Length of body $\frac{1}{900}$ inch.

Hab. Pond water, on the rootlets of *Lemna*. Solitary.

In form this resembles *V. octava*, Stokes *, but is readily recognized as different by its persistence of shape, by the proportionate length of the pedicle, and especially by the absence of the peculiar twisted appearance of the sheath.

* This journal, June 1885.

Vaginicola ampulla, sp. nov. (Pl. I. fig. 21.)

Lorica retort-shaped, erect, about three times as long as broad, widest posteriorly, tapering thence to the rounded point of attachment, and anteriorly to the curved neck-like portion; aperture obliquely directed, the margins very slightly everted, the frontal border truncate; enclosed animalcule, when fully extended, projecting for about one third of its length beyond the lorica. Length of lorica $\frac{1}{125}$ inch.

Hab. Fresh water; attached to filamentous Algæ.

The lorica is hyaline when young, becoming deep chestnut-brown with age. Very frequently individual loricæ were observed with varying proportions of the posterior region coloured and semiopaque, while the frontal portion remained colourless and transparent, others with the entire sheath darkly tinged being almost as numerous. This leads me to suggest that *Vaginicola vestita* (the *Planicola vestita* of De Fromentel), in which the colour is described as being restricted to the posterior part of the lorica, may have been diagnosed from an Infusorian approaching maturity, and consequently beginning to assume its mature coloration. This seems more plausible than Saville Kent's conjecture that the sheaths may have been repaired, or that the animalcule had occupied an old and deserted lorica on which it had built a new frontal addition.

BALANITOZOON *, gen. nov.

Animalcules free-swimming, ovate or subpyriform, persistent in form, not cuirassed, the anterior portion of the cuticular surface clothed with vibratile cilia, the posterior region naked; oral aperture apical, without larger adoral cilia; pharynx apparent; a single postero-terminal seta present; animalcules leaping as well as swimming.

Inhabiting fresh water.

The ciliation of the anterior one half or two thirds of the cuticular surface, the absence of a series of differentiated oral cilia, and the reduction in the number of the springing hairs to one, and the position of that one on the posterior extremity of the body, exclude this remarkable Infusorian from the Halteriidæ of Claparède and Lachmann. Its ordinal position, the writer supposes, is among the Peritricha, although there is at present no type known in that infusorial order to which it bears a resemblance, the extensive ciliation of the anterior region and the absence of distinct oral cilia being characteristic of *Balanitozoon* alone. Only a slight effort of the imagi-

* βαλανίτης, shaped like an acorn; ζῶον.

nation is needed to further suggest that this form is connectant or transitional between the Holotricha and the Peritricha, the presence of cilia on the posterior body region being alone needed to relegate the creature to the former order, and the development of distinctly differentiated adoral cilia, in addition to the cuticular series now existing, being only necessary to admit it as an undoubted member of the Peritricha. Its peculiar springing or leaping movements call to mind the similar saltatory efforts of *Halteria*. Occasionally a depression is formed around the body at a short distance from the posterior extremity, when the little creature not remotely resembles an acorn in its cup, an appearance that suggested the generic name.

Balanitozoon agile, sp. nov. (Pl. I. fig. 19.)

Body conical or subpyriform, less than twice as long as broad, widest and truncate posteriorly, thence tapering to the frontal border; the anterior two thirds only of the cuticular surface clothed with long adcurved cilia; posterior terminal seta subequal to the body in length, its distal extremity usually curved; oral aperture apical; anal opening not observed; contractile vesicle single, spherical, situated near one side of the posterior border; nucleus small, subspherical, placed near the centre of one lateral margin; endoplasm colourless, often granular posteriorly, and enclosing coloured food particles; movements rotatory on the longitudinal axis, with frequent and violent lateral leaps. Length of body $\frac{1}{1800}$ inch.

Hab. Standing water, with *Sphagnum*. Reproduction by transverse fission.

The cuticular cilia appear to be disposed in distinct parallel circles, not in the spirals so common to the Peritricha. Neither is there any sign of the peritrichous arrangement of an anterior or adoral ciliary wreath where one arm of the spiral descends into an oral fossa, since no fossa exists here, the oral aperture being a minute orifice followed by a short but distinctly visible pharyngeal passage. The cilia are comparatively long and are usually curved towards the frontal extremity.

The movements, in addition to the sudden lateral leaps, which are presumably caused by the action of the postero-terminal seta, are rapid and erratic. Reproduction is by transverse fission, the springing seta being developed from the posterior portion of the anterior moiety, and projecting obliquely from and beyond the deepening constriction for a long time before the final separation of the animalcule.

Uroleptus Sphagni, sp. nov. (Pl. I. fig. 20.)

Body clavate or broadly obovate, depressed, three times as long as broad, extensile posteriorly; widest and rounded anteriorly, somewhat curved towards the left-hand side, thence tapering to an attenuate, usually pointed, caudal prolongation, which, when extended, equals or exceeds in length the greatest width of the body; lip crescentic, prominent; anterior border somewhat curved towards the dorsal aspect, thus forming a conspicuous transverse groove or depression on the frontal region of the dorsum; peristomial field broad, extending through the anterior one third of the ventral surface, its posterior termination curved toward the right-hand side, the left-hand margin bearing the adoral and a series of fine paroral cilia, the right-hand border finely ciliated and supporting an undulating membrane; frontal styles four or five; ventral setæ in two median lines extending into the caudal prolongation; marginal setæ projecting posteriorly, those on the left-hand side originating at the posterior extremity of the peristomial field in close proximity to the ventral setæ, and extending obliquely and longitudinally towards the posterior portion of the left-hand border; contractile vesicle single, spherical, on the left-hand side of the peristome-termination, near the body-margin; nucleus double, elongate-ovate, with a laterally-attached nucleolus; dorsal hispid setæ numerous, fine and short; anal aperture on the left-hand border of the dorsal surface near the origin of the caudal prolongation. Length of body $\frac{1}{150}$ inch.

Hab. Standing water, with *Sphagnum*.

The caudal prolongation is very frequently extended until it becomes almost filiform. It is then also often arcuately curved. In the numerous specimens examined I have been able to determine the existence of but one nucleolus, which is attached to the anterior nuclear nodule. Even the use of reagents failed to disclose a second.

EXPLANATION OF PLATE I.

Fig. 1. *Heteromita variabilis*, × 675.
Fig. 2. *Paramonas alata*. Diagram.
Fig. 3. *Clostenema socialis*, × 1225.
Fig. 4. *Cyclanura orbiculata*, × 330.
Fig. 5. *Chrysopyxis urceolata*, × 1350.
Figs. 6 & 6 *a*. *Chrysopyxis dispar*, × 1350.
Fig. 7. *Urotricha platystoma*, × 330.
Fig. 8. *Tillina campyla*, × 400.
Fig. 9. *Amphileptus moniliatus*, × 100.
Fig. 10. *Loxophyllum vorax*, × 200.

Fig. 11. *Colpidium putrinum*, × 300.
Fig. 12. *Colpidium striatum*, × 450.
Fig. 13. *Diplomastax frontata.* Ventral, × 250.
Fig. 14. *Diplomastax frontata.* Reproductive fission.
Fig. 15. *Histiobalantium agile.* Dorsal, × 300.
Fig. 16. *Histiobalantium agile.* Lateral, × 450.
Fig. 17. *Rhabdostyla pusilla*, × 500.
Fig. 18. *Vorticella Lemnæ*, × 360.
Fig. 19. *Balanitozoon agile*, × 810.
Fig. 20. *Uroleptus Sphagni*, × 135.
Fig. 21. *Vaginicola ampulla*, × 137.

Trenton, New Jersey, U. S. America.

XII.—*Descriptions of Sponges from the Neighbourhood of Port Phillip Heads, South Australia, continued.* By H. J. Carter, F.R.S. &c.

[Continued from p. 58.]

Fam. 2. Suberitida.

Group 11. Suberitina (new group).

(Proposed instead of the original groups 10, 11, and 12, viz. Cavernosa, Compacta, Laxa, and the subsequently added group, viz. Subcompacta, which the group Suberitina is intended to include as subdivisions.)

Spirastrella, Sdt. (Spongf. Küste v. Algier, 1868, p. 17, taf. iii. fig. 8).

General Observations.

This genus is chiefly characterized by its spiculation, consisting of a pin-like skeletal and spinispirular flesh-spicule, the latter, like most flesh-spicules, congregated more or less thickly into a layer on the surface; hence Schmidt placed it among his "Corticatæ" (!), our Pachytragida. But inasmuch as there are two kinds, if not species, of this sponge which possess the same form of spiculation, it becomes necessary to seek in the size of their spicules, their structures, and their adult forms respectively for their differences. Thus while the spicules in the original species, viz. *Spirastrella cunctatrix*, Sdt., may be set down as longer and thinner, those of the other kind or variety, which we shall term *Spirastrella cunctatrix*, var. *robusta*, are shorter and stouter (a fact of general occurrence too with adult spicules of all kinds even in the same specimen, as I have often stated).

It is to these two kinds of *Spirastrella* that I have long since alluded as coming both from the south coast of Australia and the Mauritius ('Annals,' 1882, vol. ix. p. 351).

Again, while the adult form of *Spirastrella cunctatrix* is more or less massive, pyramidal, and sessile, and has a comparatively open fibro-reticulate structure in the interior and a pinkish or lilac, more or less brown colour externally in the dried state; that of the variety is compressed, erect, flabellate, lobed, and stipitate, with a comparatively compact structure in the interior of a chalky consistence and an "orange-red colour" when fresh, but in its dried state light ochre-yellow throughout. Lastly, the surface of *Spirastrella cunctatrix* presents slight scar-like elevations in juxtaposition, which, becoming more and more prominent towards the lower part, may pass from simple elevations into proliferous growths or processes at the base, while the surface of the variety is uniformly smooth, especially towards the stem.

Thus contrasted, so far as my observation extends, let us pass to a brief description of the typical species as well as the variety, both of which occur in Mr. Wilson's collection.

11. *Spirastrella cunctatrix*, Sdt.

Massive, compressed, sessile, elongated, convex or arched longitudinally, wider below than above, where it terminates in a longitudinal narrow space, bounded throughout by a slight elevation of the sides, which thus converts it into a kind of trough or gutter. Consistence firm. Colour, when fresh, "tawny brown," now lilac dark-grey or lilac dark-mouse-colour. Surface consisting of a smooth dermis covering the slight elevations of the subjacent structure, which are in juxtaposition, more or less uniform in size and shape, scar-like, subsiding to a common level upwards, increasing in prominence downwards, until at the base they pass into enlarged proliferous growths. Vents numerous, confined to the longitudinal space or trough which forms the summit. Spicules of two forms, viz.:—1, skeletal, pin-like, of which the prevailing shape of the head is subglobular, varying to simple acuate (as is usually the case with this spicule wherever it occurs), shaft fusiform, finely pointed, 200 by 2½-6000ths in.; 2, flesh-spicule a spinispirular of four bends, varying under 12 by 3-6000ths in., including the spines, shaft without the spines about 1-6000th in. in diameter. Structure from without inwards consisting of a tough fibrous dermis, which covers a thick compact layer plentifully charged with the flesh-spicules of the species, passing gradually into a less compact interior mottled grey and

yellow, in accordance with the transparency of the spiculo-fibrous reticulated skeleton and the sarcode filling its interstices respectively. Size 3 in. high by 9 × 3 horizontally.

Depth 19 fath.

Obs. There is another specimen in the collection apparently of the same species, which is simply conical, with a very *smooth* surface throughout. It is 3½ in. high by 2 × 3½ in. in the base.

As an instance of the occurrence among the Suberitina of a form almost identical with that first described, although apparently a different but closely allied species, I might cite *Suberites capensis*, Carter, which is now, in its dried state, 14½ in. long and 5½ in. in diameter at the base. It is the specimen to which I have alluded in the 'Annals' for 1882 (vol. ix. p. 350) as having been brought from Port Elizabeth (Cape Colony), and now in the British Museum, bearing my running no. "10," and registered "71. 6. 5. 1." The pin-like spicule is stouter and shorter than that of *Spirastrella cunctatrix*, and the spinispirula only half the size; so that with the identity in form it can hardly be considered more than a variety of the latter.

The structural elevations of the surface in both cases appear to me to occur so often in the Suberites under different forms as to be of characteristic value, while they are most typically developed in *Rhaphyrus Griffithsii*, Bk. (*Cliona celata*), where they present themselves in defined polygonal spaces in juxtaposition, with a papilliform area in the centre, which led Schmidt to call this sponge "*Papillina suberea.*"

12. *Spirastrella cunctatrix*, var. *robusta*, Carter.

Massive, stipitate, or much contracted at the base, compressed, flabellate, about ½ in. thick; proliferously lobed, especially on one side; lobes more or less compressed, with round, more or less crenulated, border. Consistence firm, mealy when dry. Colour when fresh "orange-red," now light ochre-yellow. Surface smooth. Vents small, congregated about the margin of the lobes. Spicules of two forms, viz.:—1, skeletal, pin-like, prevailing shape of head globular, but very variable; shaft fusiform, rather obtusely pointed, about 105 by 2½-6000ths in. more or less; 2, flesh-spicule a robust spinispirula, the thickest and largest altogether that I have seen, consisting of 2½ bends varying under 11 by 8-6000ths in., including the spines; shaft without spines, 2-6000ths in. thick; the former chiefly confined to the interior and the latter to the surface, where it forms a thick layer,

as in the typical form. Structure from without inwards, consisting of this compact stratum of flesh-spicules, passing inwards into a less compact structure composed of sarcode and skeletal spicules, the latter forming a spiculo-fibrous skeletal reticulation of a grey colour, whose interstices are filled up by a yellowish sarcode, and the whole when *dry* of course not only still more compact, but mealy in appearance and fracture. Size variable, the largest of several specimens 7 in. high by 8 × 6 horizontally.

Depth 20 fath.

Obs. This presents the same characters in structure, colour, and spiculation as that on the little crab's back now in the Liverpool Museum, which came from the Mauritius, and to which I have already alluded.

In both these forms there is a great variety in the size of the spinispirular flesh-spicule as well as in the form of the head and dimensions of the pin-like or skeletal spicule, of which only those of the largest have been given, since, as may be easily conceived, where the spicules must be small before they are great (like everything in nature), and are continually and successively being formed, this *must* be the case.

13. *Spirastrella cunctatrix*, var. *porcata* (dry).

This specimen appears to have been pyramidal in form when fresh, with a smooth surface, or only slightly characterized by the suberitic elevations to which I have alluded; but now presents a number of thick rugæ running from the base towards the apex, which appear to have arisen from a glue-like nature of the cortical layer, that has thus been thrown into folds whilst drying; but whether this consistence, of which the less compact structure of the interior more or less partakes, is natural or caused by partial decomposition I am unable to state. Certainly specimens of a similar species and form have passed through my hands; but then other similar species have, when half decomposed, presented a gluey flabby nature when wet, and a correspondingly compact gluey character when dry, although still retaining part of their original structure in a glutinized condition. In every other respect this specimen resembles *Spirastrella cunctatrix*, and has been designated a variety of it under the name "*porcata*" on account of the ploughed-field like form of the surface.

This glue-like character of the sarcode often presents itself in dried specimens. Is it owing to partial decomposition or to a naturally more inspissated condition of the sarcode?

General Observations.

Here it might be again stated that the spinispirula or flesh-spicule in the Suberitina becomes gradually diminished in size from *Spirastrella cunctatrix* downwards, so as to at last disappear altogether and leave nothing but the skeletal or pin-like spicule, as shown in the "List" to which I have referred ('Annals,' 1882, vol. ix. p. 347 &c.). Hence there may be Suberitina *without* the spinispirula or any other form that the flesh-spicule in these sponges may assume, as the following will show:—

14. *Suberites Wilsoni*, Carter ('Annals,' 1885, vol. xv. p. 113).

In this sponge, so remarkable for its carmine colour, there is *no* flesh-spicule, as may be seen by a reference to the description (*l. c.*).

15. *Suberites Wilsoni*, var. *albidus* (dry).

This is precisely the same as the foregoing in respect of its pyramidal shape, spiculation, and areniferous composition, but the surface is more even, although still retaining traces linearly of the suberitic elevation or polygonal division to which I have alluded, and, where there has been a vent, more or less torn from contraction when drying. It only seems to differ from *Suberites Wilsoni* in the absence of colour. The specimen is 6 in. high by 7 × 5 at the base. Neither original colour nor depth is given.

16. *Suberites globosa.*

Massive, globular in one specimen, globular-elongate in the other, for there are two specimens, both stipitate, rising from a thick, round, short stem. Consistence firm. Colour in the former when fresh "wax-yellow," now whitish grey; in the latter "orange-buff," now much the same. Surface smooth as glass from the compactness of the dermis. Vents in plurality on the summit of the globular form, reduced to one very large one with everted edge in the centre of the elongated one. Spicules of one form only, viz. pin-like, comparatively small, shaft fusiform, finely pointed, about 75 by $\frac{3}{4}$-6000ths in. Structure from without inwards, consisting of an extremely thin skin in the globular form, but thick (1-24th in.), tough and fibrous in the elongated one; internally the same in each, viz. very compact, mottled grey and yellow by the

presence of the sarcode in the midst of the spiculo-fibrous skeleton. Size of globular form 1⅝ in. in diameter; that of the elongated one 3 in. high by 4½ × 2½ horizontally.

Depth 19 and 18 fath. respectively.

Obs. Somewhat different as these two forms are they nevertheless appear to me to belong to the same species; hence they have been described together under the same designation.

17. *Suberites flabellatus.*

Massive, thick, flabellate, stipitate, lobate on the surface; stem thick. Consistence soft, resilient. Colour when fresh "dull orange-brown," now dull ochre-yellow. Surface smooth, presenting every degree of lobulation from simple elevation to proliferous processes. Vents rather large, surrounded by a thin projecting margin, scattered irregularly over the surface and on the prominent ends of the proliferous growths. Spicules of one form only, viz. pin-like, prevailing form of head subglobular, varying to simple acuate; shaft fusiform, fine-pointed, about 190 by 3-6000ths in. Structure internally from without inwards, consisting of a thin dermal covering, followed by spiculo-fibrous skeletal reticulation imbedded in sarcode, which becomes brown, stiff, and gluey when dry. Size 5½ in. high by 5½ × 2½ in. horizontally.

Depth 7 fath.

18. *Suberites biceps.*

Massive, stipitate, terminating above irregularly in pointed lobes; stem thick. Consistence firm. Colour when fresh "crimson," now pinkish grey. Surface smooth, minutely reticulated. Vents scattered over the surface, chiefly towards the lower part. Spicule of one form only, viz. acerate, slightly fusiform, globularly inflated at each extremity (hence the designation), 185 by 1½-6000th in. Structure from without inwards, consisting of a thin reticulated dermis followed by a subcompact tissue imbedding the spicules of the species in a fibro-reticulated skeletal mass traversed by the excretory canals which end at the vents mentioned. Size 3 in. high by 2½ horizontally.

Depth 19 fath.

Obs. This form of skeletal spicule is not uncommon in combination with flesh-spicules (anchorates and tricurvates &c.); and with sparsely-spined ends occurs in *Suberites fistulatus*, Carter, from South Australia ('Annals,' 1880, vol. vi. p. 53, pl. v. fig. 22). The pin-like inflation at each end of

this spicule shows that the *pin-like form alone* cannot be considered "monactinellid" (one-rayed) any more than the simple acerate, which consists of two rays growing in opposite directions from the central cell. "Diactinellid" would etymologically suit this form best (two-rayed).

19. *Suberites insignis.*

Massive, sessile, depressed, elliptical, slightly convex, truncated below; covered with warty tubercles at one end and with large thin-mouthed vents at the other, each in juxtaposition, with a smooth space in the centre between them, altogether looking very much like a large sea-slug. Consistence firm, tough. Colour when fresh "dark slate-grey," now much the same, with a tinge of violet-red. Surface smooth, dermis thin. Vents congregated chiefly over one end. Spicules of one form only, viz. pin-like; head varying from subglobular to simple acuate, 100 by 1¼-6000th in. more or less. Internal structure cavernous, tissue compact. Size 1½ in. high by 4 × 2½ horizontally.

Depth 19 fath.

Obs. This is a very remarkable sponge on account of its structure, which consists chiefly of enormously dilated excretory canals, into which the water &c. entering through the pores and their subdermal cavities is received and discharged by the vents; while the surface of the excretory canals as usual presents the characteristic subcircular rugæ together with the apertures of small canals between them. Passing from the surface inwards the dermis may be observed to be composed of a finely reticulated structure, in each interstice of which are several pores whose apertures lead into the subjacent subdermal cavities, which together form a layer that is continued *over* the warty tubercles as well as *over* every other part of the surface, forming in many parts the outer wall or roof of the great dilated excretory canals, which thus receive the contents of the subdermal cavities through holes corresponding to the pores externally, and finally eject them, or such parts as are not necessary for the nourishment of the sponge, through the large thin-mouthed vents at the other end of the specimen, thus affording another instance of a *direct communication* between the pore and excretory canal systems. The "cavernous" structure seems to find an analogue in the similarly-dilated canal-structure (*lacunæ*) of *Chondrosia reniformis*, Nardo, and *C. Ramsayi*, Von Lendenfeld (Proc. Linn. Soc. N. S. Wales, vol. x. pt. 1, p. 147, pl. iii), of which there are two or more specimens in Mr. Wilson's collection from "Western Port."

20. *Suberites parasitica.*

This consists of a thin layer of small pin-like spicules about 40 by 1-6000th in., together with others of ? *Halichondria panicea* about twice the length, parasitically covering a fucus (*Thamnoclonium flabelliforme*, Harvey, Freemantle. See 'Annals,' 1878, vol. ii. p. 162 &c., "Parasites on the Spongida").

Group 13. POLYMASTINA (new group).

21. *Polymastia bicolor.*

Massive, flattish, slightly convex, circular, sessile, bossed with slightly convex circular knobs of a dark grey-brown colour, set as it were in a yellowish flat mass; "bosses" varying in diameter under ¾ in. Consistence hard, firm. Colour when fresh "dark grey-brown," now, as just mentioned. Surface dermally smooth, especially over the dark projecting portions or "bosses." Vents lateral and towards the base. Spicules of one form only, but of two sizes, according to their position:—1, skeletal, subpin-like, varying to simple acuate, 150 by 2⅓-6000ths in.; 2, the same, but much smaller, viz. 10 to 20-6000ths long; the former radiating in bundles from the interior to mingle their points with a layer of the latter, which are confined to the surface. Structure consisting from without inwards of an areniferous dermal layer of a yellow colour, followed by a tough compact basal tissue composed of radiating bundles of the large spicule traversing a yellow sarcode and extending in a diminishing degree, core-like, through the centre of the bosses, where its presence at the summit can just be distinguished; bosses otherwise composed of the same radiating kind of spicular structure, but in a dark grey sarcode, which makes the difference on the surface that led to the designation "*bicolor.*" Excretory canal-systems traversing the whole in such a peculiar form that it will be desirable to describe this particularly in the "Observations." Size 1½ in. high by 3 × 4½ horizontally.

Depth 7 fath.

22. *Polymastia bicolor*, var. *glomerata.*

The same, but with the bosses enlarged and elongated so as to obscure the yellow basal structure beneath, and thus only present a conglomeration of mamilliform processes.

23. *Polymastia bicolor*, var. *crassa*.

The same, with only three or four processes of much greater length, one of which is 2 in. long by ½ in. in diameter at the base.

Obs. Not being able at first to see any vents about the specimens, which, as before stated, present a more or less areniferous dermal coat of a yellow colour over the basal structure, that is between the bosses or mamilliform appendages, I slit open the largest process of no. 23, and found that the excretory canal commenced in small branches towards the summit, in a spongy tissue which, formed of a labyrinthic hypertrophy of the pore and subdermal cavity-structure, filled up the end and sides of the mamilliform extension; and tracing these downwards by means of their size and the subcircular folds which characterize an excretory canal, they were observed to unite into a single trunk, which, when pursued through the yellow tissue of the body, was found to end in a vent situated laterally towards the base of the specimen; thus affording still another instance of a direct communication between the pore and subdermal cavity and the excretory canal-systems at the surface of a sponge. This was also found to be the case in the bosses of *Polymastia bicolor* and in the mamilliform processes of no. 22.

There is a dry specimen of *Polymastia bicolor* among the late Dr. Bowerbank's specimens from the south coast of Australia, now in the British Museum; but it must have been much larger when fresh, for it is now 1½ in. high by 7½ × 5½ horizontally. Indeed there are so many specimens of this species in Mr. Wilson's collection that it, like many others, must be very abundant about Port Phillip Heads. Dr. v. Lendenfeld states that his *Aplysilla violacea* covers "many thousand square metres in Port Phillip" (Proc. Linn. Soc. N. S. Wales, vol. ix. p. 311).

Here I would observe with reference to a former statement as to the "vents" of *Desmacidon Jeffreysii*, Bk. = *Oceanapia*, Norman, not having been discovered ('Annals,' 1882, vol. x. p. 119), that it is just possible that they may be found on a level with the surface of the sponge quite independently of the long tubular appendages, which, being in structure very much like the mamilliform processes of *Polymastia*, may in like manner be simply for *inhalent* purposes; except by accident, when the end of the tube may be converted into a vent.

24. *Polymastia massalis.*

Massive, irregularly hemispherical, truncated (? cut off by the dredge) at the base; scattered over with small wart-like conical processes, like mamillæ in miniature, not being more than ⅛ in. long. Consistence compact, firm. Colour when fresh "purplish brown," now light yellow-grey throughout. Surface smooth. Vents in plurality, partly at the ends of the warty processes and partly on a level with the surface. Spicules of two forms, viz:—1, skeletal, acuate, very long, 130 by ⅜-6000th in.; 2, subpin-like, 30 by ½-6000th and under; the former in bundles radiating from the body, and the latter confined to the surface, where they form a layer intermingled with the points of the skeletal bundles. Structure compact, traversed by the canals of the excretory systems, which open at the vents mentioned. Size of specimen 1¼ in. high by 3 × 3 horizontally.

Depth 19 fath.

Obs. The mamilliform processes in this species differ in structure from those of the foregoing species and its varieties, inasmuch as "the vents" are distinctly in some of the mamilliform processes, which then seem to be entirely devoted to them, while in others the same kind of structure prevails as in *Polymastia bicolor* &c.

Group 14. TRACHYINA (new group).

25. *Trachya globosa.*

Globular, stipitate; stem thick, cylindrical. Consistence firm, unyielding. Colour when fresh "bright ochre-yellow," now whitish grey. Surface smooth, but uneven, from the dermal layer overlying slight elevations of the subjacent structure. Vents scattered round the summit coronally. Spicules of two forms, viz.:—1, skeletal, acerate, exceedingly long, fusiform, gradually diminishing on each side to a very fine point, 1000 by 9-6000ths in., or about ⅙ in. long; 2, flesh-spicule, bihamate (fibula), C- and S-shaped, very minute, viz. about 2-6000ths in. long; the former arranged in bundles radiating from a condensed centre to the circumference, the latter confined to the sarcode. Structure from without inwards consisting of a thick dermis, followed by a radiating arrangement of the skeletal spicules in bundles from the condensed centre to the circumference, imbedded in sarcode, which is abundantly traversed by excretory canals, especially towards the border. Size of head about 2¼ in. in diameter; stem, which is truncated (? cut off by the dredge), ½ in. in diameter.

Depth 19 fath.

Obs. There are four specimens of this sponge, all more or less alike, but one is double-headed. At first they look so much like specimens of *Donatia* that one is inclined to place them in the same group; however, the stipitate form (there is no stem in *Donatia*) and the spiculation soon dispels this delusion.

Group 15. DONATINA.

26. *Tethea Cliftoni*, Bk.

Tethea Cliftoni, Bk., Proc. Zool. Soc. 1873, p. 16, pl. iii. figs. 14 &c.
Donatia, Gray, *ib.* 1867, p. 541.

This seems to me to be only an enlarged form of our *Donatia lyncurium*, and therefore ought to be considered a variety rather than a distinct species. The surface is more prominently tuberculated and the root-like appendages larger and more prolonged than in the British species; but the colour is pink or orange when fresh and the spiculation and internal structure are nearly the same. There are several specimens in Mr. Wilson's collections averaging 2 inches in diameter, which is twice the size of the British species (see my illustrated description of the latter, 'Annals,' 1869, vol. iv. p. 7, pl. ii. figs. 1–3). In distribution it seems to be "world-wide."

Group 19. CHONDROPSINA (new group, provisional).

27. *Chondropsis arenifera.*

More or less globular, sessile. Consistence firm, almost unyielding. Colour when fresh "buff or reddish grey," now whitish grey externally. Surface irregular, but smooth. Vents numerous, irregular in size, large, scattered over the surface, especially round the summit. Spicules of two forms, accompanied by a great quantity of sand:—1, Skeletal, cylindrical, with obtuse ends, 70 by $\frac{2}{3}$-6000th in.; 2, acuate, much smaller, viz. 50 by $\frac{2}{3}$-6000th in. Sand diffused, not circumscribed, that is not in the form of fibre. Structure from without inwards consisting of a thin reticulate dermis whose fibre is charged with minute acuates mixed with grains of sand, passing into a cartilaginous fibreless tissue partly charged with the spicules above mentioned in yellow sarcode, and partly with grains of sand *throughout*, that is presenting no nuclear condensation. When dry the sand appears in aggregations distinct from the yellow sarcode, then of a brown colour like glue, in which the spicules are chiefly imbedded. Size of

largest specimen (of which there are three) globular, nearly 3 in. in diameter.

Depth 20 fath.

Obs. This specimen is infested with a short oscillatorian parasite in great abundance, whose filaments vary in length under 25-6000ths in. The species has been *provisionally* inserted here for the reasons mentioned in my observations on the "group," p. 45 *antea*).

Group 25. STELLETTINA.

28. *Stelletta bacillifera*, var. *robusta*, Carter ('Annals,' 1883, vol. xi. p. 351).

Massive, globular, sessile, or attached by one part of its circumference. Consistence hard. Colour when fresh "dull maroon-red," now sulphur-yellow, *internally*. Surface hard, minutely granulated. Vents scattered here and there over the body, chiefly towards the point of attachment. Spicules of four forms, viz.:—1, "the body-spicule," as usual, a large acerate, 245 by 1½-6000th in.; 2, "zone-spicule" or tetractinellid, arms simple, expanded laterally and rather recurved, head 11-6000ths in. broad, shaft 120 by 1½-6000th in.; 3, flesh-spicule, bacillar, 12 by 1-6000th in., spined all over; 4, flesh-spicule, stellate, 2 6000ths in. in diameter. No "forks" or "anchors" were seen, which may or may not be a constant feature. Flesh-spicules confined to the dermal layer, which is thin and receives the heads of the zone-spicules, together with the outer ends of the body-spicules or large acerates. Structure internally consisting of the body-spicule chiefly, imbedded in sulphur-yellow sarcode, which still retains its brilliancy, traversed largely by the canals of the excretory systems, especially about the centre. Size of specimen 1¾ in. in diameter.

Depth 19 fath.

Obs. If not the same this seems to differ so slightly from *Stelletta bacillifera*, var. *robusta*, Carter (*l. c.*), as not to require a distinct appellation; but as the latter was described in the *dried* state, in which the colour of the interior when fresh could not be determined, I have thought it desirable to describe Mr. Wilson's specimen also, as the *yellow colour* of the interior is so bright and striking. Of course, to become better acquainted with the species it will be advisable to read what I have published on the subject where the original has been described.

29. *Stelletta æruginosa.*

Globular, sessile, that is adhering by one part of the cir-

cumference only to the object on which it may be fixed. Consistence hard. Colour verdigris-green or blue throughout. Surface smooth. Vents irregularly scattered over the surface. Spicules of five forms, together with a large pigmental cell, viz. :—1, body-spicule, as usual, a long acerate, 288 by 2½-6000ths in.; 2, zone-spicules or tetractinellids, arms simple, remarkably long, at first projected for a little distance anteriorly and laterally, and then horizontally for the rest of the course, head 100-6000ths in. in diameter, shaft 344 by 3-6000ths in.; 3 and 4, anchors and forks, each with short thick arms and, as usual, long shafts, the former plentiful, the latter small and scanty; 5, flesh-spicules, stellates of two sizes, the largest about 6- and the smallest 2-6000ths in. in diameter, rays spined verticillately. Pigmental cell globular or slightly elliptical, distinctly nucleated and granuliferous, granules brown; cell 4-6000ths in. in diameter, granules strongly marked, 1 6000th in. Structure compact, consisting from without inwards of a fibrous dermis in which are imbedded the pigmental cells (which, from their comparatively large size, are striking objects), together with the smaller stellates, the outer points of the body-spicules, and the heads of the zone-spicules all mixed together. Size variable, under an inch in diameter.

Depth about 6 fath.

Obs. There are upwards of a dozen specimens of this sponge under the size above mentioned down to that of a pea, and all attached to different objects, sometimes one or two together or following each other, especially on the stalks of *Chalina polychotoma*. Like the foregoing, they do not part with their colour on being kept in spirit. Direct communication between the pore-structure and the cavities of the excretory canals is presented at their circumference.

30. *Stelletta mamilliformis.*

Globoconical, mamilliform, sessile. Consistence tough, dense. Colour whitish, colourless. Surface rough, being more or less covered with grains of sand agglutinated to the dermis. Vent single, terminal, large. Spicules of five forms, together with a pigment-cell, viz. :—1, body-spicule, as usual, a long large acerate, 345-6000ths in. in length; 2, zone-spicule or tetractinellid, arms at first simple, then bifurcate, the simple or proximal part projected anteriorly and laterally, and the forked part horizontally, head 84-6000ths in. in diameter, shaft 344-6000ths in. long; 3 and 4, anchors and forks present as usual, with long slender shafts and more slender arms than those of the foregoing species; 5, flesh-

spicules, stellates of two sizes as usual, viz. 6- and 4-6000ths in. in diameter respectively. Pigmental cells globular or slightly elliptical, distinctly nucleated and granuliferous, granules brown, sometimes colourless; cell 4-6000ths in. in diameter, granule 1-6000th in. Structure compact, consisting from without inwards of a thin fibrous dermis charged with grains of sand, pigmental cells, and stellates, in which are imbedded the distal ends of body-spicules together with the tetractinellid heads of the zone-spicules. Size about ½ in. in diameter.

Depth not mentioned, being one of a great number of small specimens tied up in a cloth.

Obs. There are two of these which have grown together, indicative of their having belonged to a group, thus growing like the yellow variety of *Tethya* (*Stelletta*) *dactyloidea*, Carter, in the sandy estuary of Mahim at Bombay ('Annals,' 1869, vol. iii. p. 15, and 1872, vol. ix. p. 82).

31. *Stelletta geodides.*

Subglobose, sessile. Consistence hard. Colour when fresh "dark slate," the same now. Surface minutely granulated over low mulberry-like elevations. Vents small, numerous, in the grooves between the elevations. Spicules of four forms, together with a pigment-cell, viz.:—1, body-spicule, as usual a long large acerate, about 600 by 6-6000ths in.; 2, zone-spicule or tetractinellid, in which the arms are simple, very short and thick comparatively, rather recurved and projected forwards and laterally, head 20-6000ths in. in diameter, shaft 375 by 6-6000ths in. No anchors or forks seen. 3, flesh-spicules, solid, elliptical, microspined all over, 2 by ⅔-6000th in.; 4, flesh-spicule, stellates varying under 5-6000ths in. in diameter. Pigmental cell large, globo-elliptical, 10 by 8-6000ths in. in diameter, distinctly nucleated and granuliferous, granules large and brown-coloured. Structure from without inwards consisting of a dark cortex about $\frac{1}{24}$ in. in thickness, of which the outer half is composed of a layer of the flesh-spicules, nos. 3 and 4, imbedding the distal ends of body-spicules and the heads of the zone-spicules; and the inner half is composed of the subdermal cavities circumscribed by tissue charged with the pigmental cell, followed by the body-substance, which chiefly consists of the body-spicules and the sarcode scantily charged with stellates and plentifully traversed by the canals of the excretory system which end in the vents mentioned. Size 2½ in. in diameter.

Depth 13 fath.

Obs. The cortical layer, which in its outer half is chiefly

composed of the spiniferous, elliptical, solid bodies, gives this sponge very much the character of a *Geodia*; hence the designation. But the alliance is between these flesh-spicules and the bacilliform bodies of *Stelletta bacillifera*, var. *robusta*, rather than with the siliceous balls of *Geodia*, as may be seen by their structure and development, together with a reference to the illustrations of the varieties in form assumed by the *bacillar* flesh-spicules given in connexion with my description of *S. bacillifera*, var. *robusta* ('Annals,' 1883, vol. xi. p. 351, pl. xiv. fig. 3, *g*).

Group 26. STELLETTINOPSINA (new group).

32. *Stellettinopsis simplex*, Carter ('Annals,' 1879, vol. iii. p. 349, pl. xxviii. figs. 16–18).

33. *Stellettinopsis tuberculata*.

Massive, sessile, nodularly tuberculated; tubercles agglomerated into groups. Consistence hard. Colour when fresh "dull purple-brown," now dark brown. Surface rough, *i. e.* minutely and uniformly granulated. Vents small, numerous, and in the sulci between the agglomerated tubercles. Spicules of two forms, viz.:—1, skeletal, a large, smooth, acerate, 180 by 3-6000ths in.; 2, flesh-spicule, a minute stellate about 2-6000ths in. in diameter. Structure from without inwards consisting of a thick dark dermal layer charged with sand and stellates, traversed by the distal ends of the body-spicules which are situated near the surface, followed by a compact body-substance composed of the large acerate spicule imbedded in sarcode of a lighter colour than the dermis charged with the minute stellate. Size 4½ in. high by 4 × 3 horizontally.

Depth 3 fath.

34. *Stellettinopsis coriacea*.

A large, irregularly shaped (*i. e.* amorphous) fragment. Massive, enclosing bivalve shells an inch in diameter in its tissue; partly covered by a remarkably thick smooth skin. Consistence firm. Colour when fresh "dull purple," now dark pinkish slate, turning to madder-red under the action of liq. potassæ or nitric acid. Surface characteristically smooth. Vents in small groups here and there. Spicules of four forms, viz.:—1 and 2, skeletal, large acerates and acuates about the same dimensions, viz. 324 by 4½-6000ths in.; 3, small acerates, about 25-6000ths in.; 4, flesh-spicule, the usual small stellate, about 2-6000ths in. in diameter. The skeletal spicules are

chiefly confined to the body and the small spicules to the surface. Structure from without inwards consisting of a thick, fibrous, tough, and smooth dermal layer, now of a dark pinkish slate-colour, as above stated, charged with the small or flesh-spicules, and contrasting strongly in colour with the body-substance, which is much lighter and composed of the body-spicules chiefly. Fragment about 3 in. in diameter.

Depth 20 fath.

Group 28. TETHYINA.

35. *Tethya cranium*, var. *australiensis*.

Massive, elliptical, convex, truncate, sessile (? cut off at the base by the dredge). Consistence tough, firm. Colour when fresh "yellow," now much the same, but faded. Surface finely hispid. Vents small and numerous, here and there among the pores of the reticulated dermis. Spicules of four forms, viz.:—1, skeletal, the body-spicule, an extremely long acerate, fusiform, with elongated and finely pointed extremities, 1350 by 9-6000ths in., *i. e.* about $\frac{1}{4}$ in. by about 1-600th; 2, zone-spicule or tetractinellid, arms simple, extended fork-like, about 32-6000ths in. long, shaft a little less than that of the body-spicule; 3, a fine, minute, fusiform acerate, microspined throughout, about 50-6000ths in. long; 4, bihamate or fibula, C- or S-shaped, about 4-6000ths in. long. Structure from without inwards consisting of a thin fibro-reticulate dermis, charged with the bihamate flesh-spicule, in the interstices of which reticulation the pores are situated, and through which the distal ends of the body-spicules and the trifid ones of the tetractinellids project, which gives the surface its fine, delicate, hispid character, followed inwardly by a compact structure, composed of bundles of the skeletal acerates radiating from the centre towards the circumference, held together by the sarcode, charged with the microspined acerates and the bihamate flesh-spicules, and traversed by the canals of the excretory systems. Size $4\frac{1}{2}$ in. high in the centre by $2\frac{1}{2} \times 1\frac{1}{2}$ horizontally.

Depth 20 fath.

Obs. The presence of the fine microspined acerate in great abundance throughout the body-substance is the chief distinguishing character of this variety. I saw no anchors (smaller tetractinellids with *recurved* arms); but as their heads when exposed are generally broken off (for they catch in everything that they touch), it does not follow that they do not form part of the spiculation, particularly as they are present in most of the other species that have been described.

XIII.—*Report on the Testaceous Mollusca obtained during a Dredging-excursion in the Gulf of Suez in the Months of February and March* 1869. By ROBERT MACANDREW.—*Republished, with Additions and Corrections, by* ALFRED HANDS COOKE, M.A., Curator in Zoology, Museum of Zoology and Comparative Anatomy, Cambridge.—Part IV.

[Continued from vol. xvi. p. 276.]

Shell.	Station.	Distribution.	Remarks.
BULLIDÆ.			
Buccinulus [Actæon] coccinatus, *Reeve.*	Rare; five specimens.	New Guinea. [Philippines. New Caledonia, New Hebrides, N.E Australia, Moreton Bay, Port Jackson.]	The species, when sufficient specimens have been examined, will probably turn out to be a variety of the common *solidulus*, L., from which it appears to differ simply in the colour and in the shortness of its spire.
—— suturalis, *A. Ad.*	Three specimens.	*Persian Gulf. [Cape York.]	In many points not unlike *coccinatus*; but the shell is uniformly narrower, the suture much deeper, and the colouring, while the same in kind and varied by similar white bands, disposed in much fewer stripes, at a greater distance from one another, which follow a regular curve, not, as in *coccinatus*, an irregular zigzag.
—— tessellatus, *A. Ad.* ..	Ten specimens.	Red Sea, *Persian Gulf.	
Hydatina physis, *L.*	Three specimens.	Mauritius. [Bombay, Seychelles, Philippines, Japan, Moreton Bay, Port Jackson, Natal.]	
Cylichna decussata, *A. Ad.*	Not common.	China Sea.	Very much of the same pinched form as our British *Cylichna truncatula*.
—— Villersii, *Aud.*	Not common.		
—— biplicata, *A. Ad.*	Four specimens.	China Sea.	Quite different from the specimens thus labelled in the Brit. Mus. and from

			Adams's description in the 'Thesaurus;' I am unable, however, to identify it with any known species.
— *minuta, *H. Ad.* [= Villersii, *Aud.*].	....	....	This is the "sp. frequent." It is described very briefly, but figured, in P. Z. S. 1872, p. 11, and appears to me the same shell as Audouin's *Villersii* (see Issel, Malac. del Mar Rosso, p. 170). It is not the *Cylichna minuta* of Brazier (Proc. Linn. Soc. N. S. W. 1877, p. 80), from Darnley Island, Torres Straits.
— pulvisculus, *Ehr*.....	Frequent	... .	I have not been able to verify this. A. Adams, in the 'Thesaurus,' makes the characteristic mistake of twice calling it *pulvisulcus*.
— bizona, *A. Ad*..	Rare.	China Sea [Torres Straits, Princess Charlotte Bay, Cape York.]	
Tornatina olivæformis, *Issel* [=fusiformis, *A. Ad.*].	Not rare.	[Cape York, Torres Straits. Port Jackson.]	I can discover no difference, either in the description given by Issel or in the shells themselves, to warrant the separation of this species from *fusiformis*, A. Ad.
— *voluta, *Quoy*	[Fifteen specimens.]	[Island of Ticao, Torres Straits.]	Spire rather more produced than in the type.
— *fusiformis, *A. Ad*...	[One specimen.]	[China Seas. Japan.]	
— * pusilla, *Issel* [? Knockeri, *Smith*].	[Four specimens.]	....	This is a mis-identification. Issel (Mar Rosso, p. 172, pl. i. fig. 15) describes a shell which is "*minuta, anfractibus tribus*." The present shells are rather large for a *Tornatina* and have four whorls; they have also a markedly turreted apex, gradually rising, while Issel's figure represents an apex sharply towering out from the level of the last whorl, without any intermediate gradations. It appears to me that the shells are very near to *T.*

* Species and localities thus labelled are added to the original list in MacAndrew's own handwriting.

Shell.	Station.	Distribution.	Remarks.
			Knockeri, Smith, from Whydah (P. Z. S. 1870).
Tornatina inconspicua, *H. Ad.* [=planospira, *A. Ad.*].	[Eight specimens.]	. . . .	P. Z. S. 1872, p. 11, pl. iii. fig. 12. Appears to me (the type is before me) to lie very close to *planospira*, A. Ad., whose type (a very bad one, in Brit. Mus.) has a slightly more truncated spire, but does not otherwise differ essentially.
Volvula acuminata, *Brug.*	Two specimens.	Britain, European seas. [South of England, all round Scotland, Ireland, Norway, Sweden, and throughout the Mediterranean, on both sides, from Gibraltar to the Ægean.]	I have no doubt of these specimens being the familiar European species, thus adding one more to the list of shells common to both sides of the Isthmus of Suez.
Bulla ampulla, *L.*	Shore: not common in good condition.	Philippines, *Persian Gulf. [Polynesia.]	
Haminea tenera, *A. Ad.* . .	Three specimens.		
—— vitrea, *A. Ad.* [= tenera, *A. Ad.*].	Five specimens.	Philippines. [Torres Straits.]	This species simply represents the bleached form of *tenera*, and must therefore disappear. The types can be examined in the Brit. Mus. *Vitrea* (Adams, in Sowerby's 'Thesaurus,' *Bulla*, sp. 74) should properly have priority to *tenera* (*id. ib.* sp. 75); but under the circumstances *tenera*, being the fresh form of the shell, had better stand.
—— *curta, *A. Ad.*	[Nine specimens.]		
—— *æquistriata, *Smith* [=curta, *A. Ad.*].	[Nine specimens.]	. . . .	I do not think it possible to separate this species (described in Ann. & Mag. Nat. Hist. 1872, ix. p. 350) from the preceding; *æquistriata* has a slightly more obese form, being described from a larger specimen; but in all essentials the species correspond exactly. *Atys Iseli*, H. Ad. (see below), is the same species.

Atys alicula, *A. Ad.* [*Ehr.*].	Abundant; living in 5–20 fath.	Red Sea, *Persian Gulf.	See remarks on *succisa* below.
—— Ehrenbergi, *Issel* [=semistriata, *Pease*, juv.].	Shore, dead.	[Sandwich Islands.]	This species is only the young of *semistriata*, Pease (P. Z. S. 1860, p. 20), the type of which is in the Brit. Mus.
—— *Isseli, *H. Ad.* [=Haminea curta, *A. Ad.*].	[Seven specimens.]	....	Described in P. Z. S. 1872, p. 11. In the first place, this species is not an *Atys*, but a *Haminea*, the outer lip not being elevated above the spire: in the second, it is a synonym of *curta*, A. Ad. (Sow. 'Thesaurus,' *Bulla*, 72, fig. 100). The types of *Isseli* are before me and are evidently old specimens of *curta*, over which there has supervened that peculiar opaqueness of texture so common in old shells of this genus. This has in most of the cases almost obscured the surface-markings; but in one or two of the specimens less ancient than the rest they still remain, and I have no doubt in my mind as to the true position of the species.
—— naucum, *L.*, var. . .	Dead.	Borneo [Ceylon, Solomon Islands, New Ireland, Torres Straits.]	
—— succisa, *Ehr.* [=cylindrica, *Helb.*].	Dead.	Red Sea. [Seychelles, Ceylon, Philippines, New Guinea, Cape York.] *	Quite undistinguishable from *alicula*, Ehr.; the only difference which can be made out from Adams's descriptions (Sowerby, 'Thesaurus,' *Bulla*, sp. 85, fig. 116, sp. 95, fig. 126) is that *succisa* has a truncated base, while that of *alicula* is rounded. But this distinction is not sufficient to warrant separation, nor indeed has Sowerby made any difference between the two in this respect in his figure. I regard both species, however, as merely small varieties of *cylindrica*, Helb., with which *elongata*, A. Ad. (Thes. *Bulla*, sp. 90, fig. 121), is certainly synonymous. Reeve

Shell.	Station.	Distribution.	Remarks.
			(Conch. Ic. vol. xvii.) even throws out the (for him) revolutionary suggestion, with which I concur, that *solida*, Brug., is possibly a dwarf var. of *cylindrica*. I since see that Mr. E. A. Smith (Ann. & Mag. Nat. Hist. 1872, ix. p. 344) is of the same opinion. *Delalis*, Pease, is a synonym of *succisa*, so far as the shell is concerned; but Pease, on the ground of a difference in the animal, retains the distinction, remarking (Amer. Journ. of Conch. vol. iii. p. 231) that it is impossible to decide on species of Bullidæ from the shell alone.
Atys dentifera, *A. Ad.*	Dead.	Lord Hood's Island.	
—— [angustata, *E. A. Smith*, = cylindrica, *Helb.*, juv.].	... ...	.. ..	Not in the collection. Described in Ann. & Mag. Nat. Hist. 1872, ix. p. 346. Types in the Brit. Mus. In my opinion nothing more than the very young form of *cylindrica*.
—— [miranda, *E. A. Smith*].	... .	....	Not in the collection. Described in Ann. & Mag. Nat. Hist. 1872, ix. p. 347. Type in the Brit. Mus.
Philine Vaillanti, *Issel* [= aperta, *L.*].	Common on shore; living in 3–5 fath.	[Norway to Canaries; Mediterranean; Cape of Good Hope; Torres Straits, Port Darwin, Port Jackson, St. Vincent's Gulf, Tasmania, New Zealand.]	This species, which is the *Bullæa Angasi* of Crosse and Fischer (Journ. de Conch. 1865, p. 110), is nothing more than the common *Ph. aperta*, L., of our coasts. It ranges from Norway to the Canaries and the whole of the Mediterranean. "Specimens from the Cape of Good Hope, Australia, and New Zealand appear to be specifically identical with those from North Europe" (Jeffreys, Brit. Conch. vol. v., who repeats that he has in vain attempted to discover a single characteristic by which the tropical specimens can be distinguished from the British).

—— erythræensis *H. Ad* [=aperta, *L.*].	....	....	Not in the collection. To judge from the description and figure (P. Z. S. 1872, p. 11) the species does not differ from *Vaillanti*, *i. e.* from *aperta*.
Smaragdinella *Andersoni, *Nev.*	Two specimens; dead.	[Ceylon.]	
AURICULIDÆ.			
Melampus *fasciatus, *Desh.*	Shore, dead.	[Ceylon, Philippines.]	Palish yellow or white, more coloured below the angle.
[Leuconia denticulata, *Mont.*].	....	[Norderney to Algarve. Madeira, Teneriffe, Azores, Mediterranean, both sides: Jamaica, E. coast N. America.]	This is the "*Marinula*, four species, undetermined."
Plecotrema *monilifera, *H. & A. Ad.*	....	[India, Torres Straits.]	
Siphonaria kurrachensis, *Reeve.*	Between high and low water, abundant.	Kurrachee, *Persian Gulf. [Philippines, Natal, Torres Straits.]	*Cochleariformis*, Reeve, is identical, while *siquijorensis*, Reeve, *luzonica*, Reeve, and *natalensis*, Krauss, present nothing more than such varietal differences as intensity of colour and comparative irregularity of ribs. The large number of specimens before me (over 60), presenting every possible variation in these respects, enable me to make this union with some confidence.
—— *variabilis, *Krauss*	Ras Mahommed.	....	The shells seem to me more like young or depauperate specimens of *concinna*, Sow. (Mauritius), which, indeed, Krauss (Sud-afr. Moll. p. 59) regards as a synonym of his *variabilis*; but this I doubt.

Shell.	Station.	Distribution.	Remarks.
OSTREIDÆ.			
Ostrea cucullata, *Born* ..	Low water, rocks.	Philippines. [China, New Zealand. Natal.]	Mr Hanley has shown that *cornucopiæ*, Chemn., and *Forskalii*, Chemn., are synonyms; to these may probably be added *plicata*, Chemn. (China), and *glomerata*, Gould (New Zealand).
—— frons, *L.* [cucullata, *Born*, juv.]	Valves.	West Indies.	The two or three old valves put down to this species are probably nothing else than the young of *cucullata* which have grown on the roots of seaweed; *frons* is a West-Indian species.
Pecten concinnus, *Reeve* [= sanguinolentus, *Gmel.*].	Shore, valves.	[Mauritius.]	*Sanguinolentus*, Gmel., is the same species and takes priority. Reeve's types (valves only) are in the Brit. Mus.
—— lividus, *Lam.* . . .	Frequent on Madrepore.	Persian Gulf.	
—— sanguinolentus, *Gmel.*	One young and a valve; shore.	Red Sea.	
—— senatorius, *Gmel.* . .	Shore, not frequent.	Moluccas, &c.	
—— serratus, *Sow.* [denticulatus, *Ad. & Reeve*].	Rare; valves.	Mauritius, Philippines. [Borneo.]	This is a mistake. The shell is *denticulatus*, Ad. & Reeve, which lies near to, but is distinct from, *luculentus*, Reeve, though I have noticed them on the same tablet in the Brit. Mus. A synonym of *luculentus*, Reeve, is *fulvicostatus*, Ad. & Reeve.
—— varius, *L.*	Rare; cannot be distinguished from European specimens.	Britain, Mediterranean.	One of the three specimens thus labelled is undoubtedly a worn shell of *senatorius*, Gmel.; as to the others, I quite agree that they are undistinguishable from the common *varius* of our coasts. Even M. Fischer, who only finds three species common to the Mediterranean and Red Sea, admits as much (Journ. de Conch. 1871, p. 225).

—— plica, *L.*	Frequent, 2–6 fath.	... .	Altered by MacAndrew to *flabelloides*, Reeve: but there seems no essential difference between the two species.
—— [radula, *Gmel.*]	One specimen.	[Philippines.]	Labelled on the back, in A. Adams's hand, "? a young and worn *sanguinolentus*;" but the characteristic markings of *radula*, which are quite different from those of *sanguinolentus*, are very distinct.
—— erythræensis, *Sow.* .	Not unfrequent.	Australia.	*Filosa*, Reeve, and *modesta*, Reeve, are synonyms.
Lima paucicostata, *Sow.* . .	Not unfrequent on Madrepore.	Réunion.	Another card, not mentioned in the original catalogue, contains three fine specimens, labelled *squamosa*, Lam., and afterwards altered by some unknown hand to *bullifera*, Desh. They all belong to the present species, in which the number of ribs appears to vary considerably. Some of the specimens before me have as few as nine, some as many as fifteen.
—— inflata, *Chemn.* ...	Rare; valves.	Mediterranean.	Quite undistinguishable from Mediterranean specimens, of which MacAndrew has a fine series.
—— tenuis, *H. Ad.*	Rare.	....	P. Z. S. 1870, p. 793.
—— scabra, *Born* [brunnea, *Cooke*].	Rare.	... .	Two valves and one perfect specimen, none of which are *scabra*, Born (a West-Indian species). The shells appear to be entirely new. *Lima* (*Ctenoides*) *brunnea*, Cooke: *L.* testâ rectiusculâ, subtenerâ, brunneâ, posticè vix, anticè latè hiante, costis valde numerosis coalescentibus nodosis armatâ, nodis rotundis, albidis, auriculis parvis, indistinctis, area cardinali angusta: long. ·75 in., lat. ·5 in. It differs widely from *scabra* in the character of the ribs and nodules, besides being somewhat more ventricose; also in the entirely different character of the anterior and posterior gapes.

Shell.	Station.	Distribution.	Remarks.
Lima pusilla, *H. Ad.* ..	Rare.	*Persian Gulf.	P. Z. S. 1870, p. 793.
—— fragilis, *Bolt.* [*Chemn.*]	Rare.	Philippines, Sandwich Is. [Fiji, Port Essington, Queensland.]	
Limæa pectinata, *H. Ad.* .	40 fath., valves, frequent.		
Spondylus aculeatus, *Chemn.* [gæderopus, *Lam.*].	Shallow water, on coral, &c.	Mauritius, *Persian Gulf.	It is perhaps from want of critical power that I am quite unable to separate these specimens from the well-known Mediterranean *gæderopus*, Lam. On examining series of both I can find no point of constant dissimilarity and many of constant similarity. I am aware that all other writers on Suez shells, assuming perhaps too hastily that the species of the two seas could not be identical, have identified the Suez *Spondylus* with quite other forms, generally that known as *aculeatus*, Chemn., a very doubtful identification: but I can but record my own conclusions. The genus, like so many others (e. g. *Avicula*, *Mytilus*, *Perna*), requires complete revision.
—— plurispinosus, *Reeve* . .	One valve.		
Pedum spondyloideum, *Gmel.*	In coral.	Indian Ocean, Mauritius.	
Plicatula philippinarum, *Hanl.*	....	Philippines.	
AVICULIDÆ.			
Avicula ala-corvi, *Chemn*	Rare, on coral.	Red Sea.	
—— marmorata, *Reeve* . .	One specimen.	....	A very doubtful identification.
Meleagrina margaritifera, *Lam.*	Frequent, in Straits of Jubal.	Indian Ocean, Pacific, *Persian Gulf. [Mauritius, Natal, S. Australia.]	*Cumingii*, Reeve (Lord Hood's Is.), is hardly a variety.
—— muricata, *Reeve* [= fucata, *Gould*].	Abundant at low water.	Philippines [Japan, Sandwich Is., N. and S. Australia, New Zealand.]	MacAndrew seems to have gone upon the same principle, as Reeve in the Conch.

			Icon., viz. that of making a species out of every specimen in this most variable genus. I have no space here to work the question out, but will simply record my opinion that the following species, the types of which are in the Brit. Mus., are identical, some of them not deserving even the name of a variety, viz.:—*imbricata*, Reeve; *muricata*, Reeve; *lentiginosa*, Reeve; *occa*, Reeve; *fimbriata*, Reeve; *anomioides*, Reeve; *aerata*, Reeve; *irradians*, Reeve; *nebulosa*, Conr.
—— *aerata, *Reeve* [=fucata, *Gould*].			
—— *flabellum, *Reeve* [=fucata, *Gould*].	....	....	The type of *flabellum* (in Brit. Mus.) is from Venezuela, and is a different shell.
Malleus decurtatus, *Lam.*	....	New Holland. [Torres Straits.]	
—— regula, *Forsk.*	. ...	Philippines, *Persian Gulf. [Ascension Is., S. Australia.]	
—— solitarius, *Reeve* =[decurtatus, *Lam.*].	One specimen.	Pacific.	The type (in Brit. Mus) is smashed to pieces; but, to judge from the general appearance of the fragments, it is not distinct from *decurtatus*, Lam.
—— tigrinus, *Reeve* [=decurtatus, *Lam.*].	....	Moluccas, *Persian Gulf.	Only a synonym of *decurtatus*, Lam.
Vulsella attenuata, *Reeve* [=lingulata, *Lam.*].	....	Red Sea. [Indian Ocean.]	For the identifications of the species of *Vulsella* here given, see my article in the 'Annals' for Jan. 1886, pp. 59–67.
—— corollata, *Reeve* [=rugosa, *Lam.*, non *Reeve*].	One specimen.	Zanzibar. [Red Sea, Persian Gulf.]	
—— crenulata, *Reeve* [=spongiarum, *Lam.*].	....	Red Sea.	Not the *V. spongiarum* of Reeve.
—— isocardia, *Reeve* [=spongiarum, *Lam.*].			
—— lingua-felis, *Reeve* [=spongiarum, *Lam.*].	....	Red Sea.	
—— mytilina, *Lam.* [? =lingulata, *Lam.*, var.].	Frequent.	Red Sea.	

Shell.	Station.	Distribution.	Remarks.
Vulsella rugosa, *Lam.* [spongiarum, *Lam.*].	....	Red Sea, *Persian Gulf.	The true *rugosa*, Lam., =*corollata*, Reeve; these shells are named from Reeve's erroneous idea of the Lamarckian *rugosa*, i. e. *spongiarum*, Lam.
—— spongiarum, *Lam.* ..	Common.	Red Sea.	
Isognomon [Perna] caudata, *Reeve* [=legumen, *Gmel.*].	....	[Society Is.]	The old *Ostrea legumen* of Gmelin has met with the usual fate of a variable species, and by the usual hand. Reeve has made out of it his *Perna rudis*, *linguæformis*, and *laticostata*, while *caudata* is only a remarkable malformation, produced obliquely instead of longitudinally.
—— nana, *Gould* [=nucleus, *Lam.*].	. ...	[Samoa Is., Fiji.]	This species, described in 'Otia,' p. 92, appears to me identical with *nucleus*, Lam. *Pectinata*, Reeve, *quadrangularis*, Reeve (a large form, connecting with *legumen*, Gmel.), *lobata*, Reeve, *spathulata*, Reeve, and *dentifera*, Krauss, do not differ sufficiently to warrant separation, when the genus is such a variable one.
—— quadrangularis, *Reeve* [=nucleus, *Lam.*].			
—— rostrata, *Schum.* [nucleus, *Lam.*].	....	.. ..	The single specimen (one valve only) is merely an unusually produced form of the preceding.
Crenatula avicularis, *Lam.* [=picta, *Gmel.*].	Shore; sponge.	Red Sea.	*Picta*, Gmel., and *phasianoptera*, Lam., are both synonyms of this variable shell; *modiolaris*, Lam. (Delessert, tab. xiv. fig. 2 *a*, *b*), appears a chance distortion.
—— bicostalis, *Lam.*	Shore.	Red Sea.	Probably only a variety of *picta*.
—— mytiloides, *Lam.* [=picta, *Gmel.*].	Shore.	Red Sea.	

— nigrina, *Lam.* [=picta, *Lam.*, var.].	Shore.	India.	The species, when a number of examples are examined, graduates into *picta*.
— picta, *Gmel.*	Shore.	Red Sea.	
— folium, *Gray* [picta, *Gmel.*, var.].	Shore.	Red Sea.	Not the *Cren. folium* of Reeve, which is only a var. of *picta*, Gmel. The true *Dalacia folium* of Gray is described and figured in 'Ann. of Philosophy,' 1825, and Reeve's description and figures of the same are both equally imaginary. The type specimen of Gray's *folium* (now in Brit. Mus.) is also figured by Children in a pamphlet on Lamarck's 'Genera of Shells,' in Quart. Journ. of Science, 1823, vol. xv. p. 35, pl. i. fig. 81 (as *Crenatula modiolaris*).
Pinna assimilis, *Hanl.*	Shore.	Torres Straits.	
—— hystrix, *Hanl.*	Shore; two specimens.	Amboyna, Australia.	
—— Stutchburyi, *Reeve* ..	Shore.	Moreton Bay.	
—— [bullata, *Swains.*] ..	.. ..	[Moluccas.]	One young specimen is probably to be referred to this form.
MYTILIDÆ.			
Mytilus variabilis, *Krauss.*	Abundant.	S. Africa. [Rodriguez, Goree, Sandwich Is., Australia, W. Indies?]	It appears to me that this shell is very widely distributed, and has been described under a variety of names given to but slightly differing forms. Amongst these are *exustus*, Lam. (if rightly identified, W. Indies); *crebriliratus*, Conr. (Sandwich Is.), a cleaner, longer, more shapely var.; *Morrisi*, Dunk.; *Charpentieri*, Dunk., probably a pinched or compressed form; while the Australian form of the same shell is *sulcata*, Lam.

Shell.	Station.	Distribution.	Remarks.
Mytilus Cumingianus, *Récl* [=Septifer bilocularis, juv.].	Rare.	•Persian Gulf. [Bourbon, Seychelles, Nicobars, New Caledonia, Japan, N.E. Australia, Polynesia; Natal.]	Mr. E. A. Smith, in the 'Challenger' Report, identifies this species with the young of the variable *Septifer bilocularis*. Reeve's locality, "Panama," is erroneous.
Modiola auriculata, *Krauss*	Frequent on reefs.	S. Africa. [E. Africa, Rodriguez, Kingsmill Is.]	These shells, of which a fine series is before me, form an interesting link between the typical *auriculata* (as figured in Sudafr. Moll. pl. ii. fig. 4) and *philippinarum*, Hanl. In all other respects the three forms approximate; but the wing of these specimens is not nearly so prominent as in Krauss's figure, but more so than that of *philippinarum*, forming an obtuser angle with the beaks.
—— fulgida, *H. Ad.* [=philippinarum, *Hanl.*].	[One specimen.]	....	This appears to me nothing more than a young and very shining specimen of *philippinarum*, Hanl. The species must therefore disappear. It was described in P. Z. S. 1870, p. 7, pl. i. fig. 9, the figure being a remarkably poor copy of the type.
—— glaberrima, *Reeve*. ..	One specimen, young.	Sydney.	Mr. E. A. Smith has overlooked this locality when he remarks, in the 'Challenger' Report, that the species has never been found, except at Sydney.
—— setigera, *Dunk.* [flavida, *Dunk.*].	Rare.	[Philippines.]	Quite wrongly identified; they are young specimens of *flavida*, Dunk.
—— [australis, *Gray*]	[Thirteen specimens.]	[Tasmania, N. and S. Australia, New Zealand.]	I am inclined to refer to this form a fine series, unidentified by MacAndrew. In some cases the beard has been rubbed off. These appear to me to be "dead" shells.
—— subsulcata, *Dunk.* ..	Rare.	Manilla.	
—— rhomboidea, *Hanl.* ..	[One specimen.]	Gambia.	This is a misidentification; the surface is quite smooth, not plaited. Though nearer

			nitida, Reeve, the shell is distinct from that also, and is probably new.
Lithophaga [Lithodomus] cinnamomeus, *Lam.*	....	Philippines. [Mauritius, N.W. Australia.]	Reeve's habitat, "Is. of St. Thomas, West Indies," is probably an error.
—— Hanleyanus, *Dunk.*...	Frequent.	Red Sea.	
—— [gracilis, *Phil.*]	[With *Hanleyanus.*]	[Singapore. N.W. Australia.]	On the same card and with the same label as the preceding, from which it is quite distinct.
Crenella gibba, *H. Ad.* [=compta, *H. Ad.*].	....	Persian Gulf.	
—— ornata, *H. Ad.* [compta.].	....	....	*Ornata* of the 1870 ed. is a misprint for *compta.* Here Mr. H. Adams seems to have committed the same error his brother fell into with regard to *Haminea tenera* and *vitrea* (see above), viz. that of describing the fresh and the dead forms of a shell as different species. The types are before me, and a careful study of them, coupled with Adams's description in P. Z. S. 1870, p. 792 (which brings out no essential point of difference whatever), leads to this conclusion. *Compta* is the fresh form, and should therefore stand.
Modiolaria cœnobita, *Vaill.* [=marmorata, *Forbes*].	....	Persian Gulf. [Finmark to Canary Is., Heligoland, Holland, Mediterranean, Mogador.]	In my judgment, these specimens certainly, and the species probably, belong to *marmorata*, Forbes, the common *Modiolaria* of our coasts. On carefully comparing the nine specimens labelled *cœnobita* with many examples of *marmorata* from our own, the Norwegian, and the Mediterranean coasts, I am unable to discover the slightest difference between them. Vaillant described *cœnobita* as a Suez species in the Journ. de Conchyl. of 1865, pp. 122, 123, and there admits that it is "voisine de la marmorata," but somewhat

Shell.	Station.	Distribution.	Remarks.
			inconsequently adds that "la forme est toute différente." All, however, that he says about the "forme" is comprised in the words "*testa rhomboidea, tumida,*" the rest of his description being concerned with the markings. And when, on turning out *marmorata* in Reeve, we find that he described it as *oblique rhomboidea, valde gibbosa,* we seem to have reduced the difference between the two species to a vanishing point. A further suspicious circumstance is that Vaillant says of *cœnobita.* "On la trouve en grande abondance dans l'épaisseur du manteau de certaines ascidies." I am not aware that any species except *marmorata* is known to occur in this curious habitat.
Modiolaria Ehrenbergi, *Issel.*	....	....	This appears to be correct, judging from Issel's description and figure.
—— viridula, *H. Ad.*			

[To be continued.]

XIV.—*On the Geodephagous Coleoptera collected by Mr. George Lewis in Ceylon.* By H. W. Bates, F.R.S.

[Continued from p. 81.]

Subfamily *Pterostichinæ.*

Morio Walkeri.

Morio Walkeri, Putzeys, Ann. Mus Civ. di Storia Nat. di Genova, iv. p. 216.

Kandy.

Morio trogositoides, Walker (Ann. & Mag. Nat. Hist. 1858, ii.), according to the type is very similar to *M. Walkeri* in general form, but differs in the front edge of the thorax being triangularly excised in the middle, as in *M. orientalis*, from which it differs in the frontal fovea not being dilated behind.

Morio cordicollis.

Morio cordicollis, Chaudoir, Bull. Mosc. 1880, Ess. Monogr. s. l. Morionides, p. 27.

Kandy and Balangoda.

Diceromerus orientalis.

Diceromerus orientalis, Motschulsky, Etud. Ent. 1859, p. 35 (*Stomonaxus orientalis*); Chaudoir, Ess. Monogr. s. l. Drimostomides et les Cratocérides, p. 15.

Dikoya, common in refuse.

Abacetus atratus.

Abacetus atratus, Dej. Sp. Gén. iii. p. 194; Chaudoir, Essai Monogr. s. l. Gen. *Abacetus*, p. 3 (Bull. Mosc. 1875),=*Distrigus costatus*, Nietner, Ann. & Mag. Nat. Hist. 1858, ii. p. 176.

Colombo.

Abacetus quadriguttatus.

Abacetus quadriguttatus, Chaudoir, Essai Monogr. s. l. Gen. *Abacetus*, p. 33?

Kandy, sandy river beds.

Chaudoir's specimens were from Burma. The Ceylonese insect does not in all points correspond with his description; but it does so sufficiently to show that, if it be not the same species, it is only a slight modification.

Abacetus lioderes.

Gracilis, facies *Anchomeni*, nigro-piceus, supra æneseens; antennis articulo primo sanguineo, palpis tarsisque fulvo-testaceis, femoribus tibiisque obscure rufo-testaceis; sulcis frontalibus brevibus versus oculum curvatis ibique profundioribus; thorace angusto, postice gradatim sinuato-angustato, angulis posticis oxstantibus, basi lævi; elytris profundo usque ad apicem striatis, striis lævissimis.

Long. 5½ millim.

Colombo.

Peculiar in this genus for its *Anchomenus*-like form, the thorax especially being more narrowly cordate than in other species, having its greatest width at the anterior third, and thence gradually and considerably narrowing to the base, before which the sides are briefly and strongly sinuated, causing the hind angles to project, though the base runs obliquely up on each side towards the angle. The base of the thorax has no trace of punctuation, the dorsal line does not deepen near the base, and the space between the straight and deep basal sulci and the margin is narrow and triangular. The arcuated anterior transverse sulcus is rather strongly marked; the lateral margins are explanate-reflexed. The elytral striæ have no trace of punctures.

Abacetus carinifrons.

Supra totus læto æneus, subtus castaneo-niger, sulcis frontalibus rectis usque ad oculorum margines posticos extensis et extus carina recta marginatis; thorace late quadrato-cordato, basi sat constricto, angulis posticis rectis, inter sulculos basales grosse punctato; elytris striatis, interstitiis planis; antennis pedibusque piceis vel rufescentibus, illis articulis 1–2 rufis.

Long. 5½ millim.

Colombo, in marshes.

Belongs to Chaudoir's section iv. 1. b, with the difference that the basal joint of the posterior tarsi is faintly sulcate on the outer side. The third antennal joint is certainly glabrous and not pilose, except the usual two or three bristles at the end.

Abacetus antiquus.

Abacetus antiquus, Dejean, Sp. Gén. iii. p. 246 (*Feronia*); Chaudoir, Essai Monogr. *Abacetus*, p. 37.

Distrigus submetallicus, Nietner, Ann. & Mag. Nat. Hist. 1858, ii. p. 177.

Argutor relinquens, Walker, Ann. & Mag. Nat. Hist. 1858, ii. p. 204.

Colombo.

Abacetus anomalus.

Abacetus anomalus, Chaudoir, Essai Monogr. *Abacetus*, p. 13.

Colombo.

Abacetus Nietneri

Abacetus Nietneri, Chaudoir, Essai Monogr. *Abacetus*, p. 38.
Distrigus æneus, Nietner, Ann. & Mag. Nat. Hist. 1858, ii. p. 177 (nom. præocc.).

Colombo.

Trigonotoma indica.

Trigonotoma indica, Brullé, Hist. Nat. des Ins. iv. p. 333

Colombo.

Lagarus (?) *impunctatus.*

Oblongus, niger, politus, elytris subviridescentibus; palpis, antennis et tarsis piceo-rufis; oculis convexis; thorace impunctato, quadrato, lateribus fere rectis, basi utrinque sulco profundo abbreviato, recto; elytris thorace vix latioribus, parallelis, striis lævibus novem profundis et acute insculptis, octavo et nono antice approximatis, striola scutellari nulla, interstitiis subconvexis, tertio impunctato; metasterno ventrisque basi lateribus punctulatis.

Long. 10 millim ♀.

Colombo, in marshes.

In its generic characters this *Harpalus*-like *Pterostichus*-form approaches *Lagarus* and *Omaseus*, the form of the metathoracic episterna being nearly the same as in *Omaseus niger*; but it differs from those and all other genera or subgenera of Pterostichinæ known to me by a combination of minor characters. The mentum is deeply emarginated and its central tooth is broad and deeply concave without being distinctly bifid; the palpi are rather slender, with cylindrical and truncated apical joints; the antennæ are rather long and filiform, and the second joint articulated to the middle apex of the scape; the head narrowed behind the prominent eyes, with fine and strongly curved frontal furrows; the thorax is quadrate, rather broader than long, with a deep sulcus similar to that of the *Abaceti*, but distant from the base; the elytra are equally and strongly striated, without scutellar striole or puncture on the third interstice; the prosternum is strongly margined at the apex, as in *Lagarus*; the ventral segments are without transverse furrows, the posterior tarsi slender and free from sulci. Two examples taken by Mr. Lewis, both females; hence the form of the dilated anterior tarsi of male is unknown.

Subfamily *Anchomeninæ.*

Anchomenus illocatus.

A. micanti (Nicol.) primo intuitu similis, sed pedibus flavis etc. valde differt. *A. alpino* (Motsch.) magis affinis. Gracilis, piceoniger, supra ænescens, pedibus melleo-flavis, palpis et articulis 1–3 antennarum flavis plus minusve fusco-maculatis; thorace parvo, subcordato, ante medium subangulatim leviter dilatato, deinde ad basin subrecte angustato, angulis anticis rectis, posticis rotundatis, margine laterali anguste explanato-reflexo, versus basin altiori, foveaque utrinque basali lata profunde rugulosa; elytris acute punctulato-striatis, interstitiis planis, tertio tripunctato; tarsis 4 posticis utrinque sulcatis.

Long. 5½–7 millim. ♂ ♀.

Nuwara Eliya; shores of the lake.

Distinguished from the allied species by the yellow colour of the legs; the trochanters, four anterior coxæ, and tips of the hindmost coxæ are also yellow. In the Siberian *A. alpinus*, which has similarly punctured striæ, but which is larger and more robust, the tibiæ only are tawny testaceous. *C. dolens* (Sahlb.) and *C. charillus* (Bates) are similar to *A. illocatus* in general form and colour, but have a differently shaped, *i. e.* more quadrate, thorax. *Argutor degener* and *Anchomenus illocatus*, Walker (Ann. & Mag. Nat. Hist. 1858, ii. pp. 203, 204), both belong to this species.

Anchomenus ceylonicus.

Anchomenus ceylonicus, Motschulsky, Etud. Ent. 1859, p. 36.

Dikoya; beaten from old branches.

Motschulsky's description is unusually good. It is necessary only to add that the species is closely allied to the N.W. American *A. obsoletus*, Say.

Colpodes xenos.

C. mutatori affinis, at quoad formam *C. cardiophoro* haud dissimilis; elytris sicut in hoc convexis, elongato-ovatis. Piceo-niger, nitidus, palpis et antennis fulvo-piceis, pedibus paullo obscurioribus; capite post oculos gradatim angustato; thorace elongato-cordato, lateribus postice longe sinuatis, angulis posticis rectis (apice obtusis), marginibus sat late explanato-reflexis; elytris convexis, elongato-ovatis, basi angustis, apice singulatim acuminatis, acute et sat profunde striatis, interstitiis planis tertio tripunctato.

Long. 9 millim.

Bogawantalawa, April 1st.

Belongs to Division I. of Chaudoir's monograph, 1878. The fourth tarsal joint in all the feet is bilobed, with the exte-

rior lobe in the four hinder feet the longer; the middle tarsi are grooved on each side, the hind tarsi on the outer side only; beneath, all four have a scanty, stiff, and short pubescence. The thorax is relatively long and very similar in outline to that of the New-Zealand *C. cardiophorus*, but the lateral margins are more reflexed, especially near the hind angles, than they are in that species, and the surface is smooth and glossy. The lateral margins of the elongate-oval convex elytra are also, especially in the middle, explanate-reflexed, the junction at the shoulder with the strongly curved and short basal margin forms an acute angle; the apex of the elytra is very obliquely sinuate truncate, and each elytron tapers to a short point near the suture; all the striæ are equally strongly impressed.

One example only.

Colpodes amœnus, Chaudoir.

Colpodes amœnus, Chaudoir, Ann. Soc. Ent. Fr. 1859, p. 326, = *C. splendens*, Morawitz, Bull. Ac. Petrop. v. 1863, p. 324.

Dikoya.

This fine species has a wide distribution. I have examined examples from N.W. India, Java, and Japan.

Colpodes lampriodes.

C. ruficipiti (Macleay) similis, sed differt pedibus rufo-testaceis, immaculatis, elytrisque margine apicali oblique flexuoso, apud suturam solum spinoso.

Long. 8 millim.

Hadley and Dikoya; under garden refuse.

Judging from the few words of description this appears to be the species erroneously referred by Chaudoir to the *Euplynes Dohrni* of Nietner, which is similar in shape and colours, but generically different in the fourth tarsal joints having two long equal lobes, and is unmistakably described by Nietner. Chaudoir had examined a "type provenant de Nietner;" it appears therefore that the original describer of the species confounded the similarly coloured *Colpodes* with his *Euplynes*. Chaudoir himself had apparently never seen a *Euplynes*, as he referred Schmidt-Göbel's *Euplynes cyanipennis* in both his monographs (1859 and 1879) to *Colpodes ruficeps*, Macl. With regard to Macleay's species, I think that Chaudoir also made a mistake, but this arose from Macleay's unsatisfactory description. *C. ruficeps* appears to be peculiar to Java and Sumatra*, and to differ from the nume-

* An example taken by Dr. Beccari on Mount Singalang was kindly communicated to me by Dr. Gestro of the Museo Civico of Genoa, together with a specimen of *C. smaragdinipennis* (Chaud.) from the same locality.

rous allied species in the elytra being transversely truncated near the suture and being there bispinose, *i. e.* there is a short spine at the sutural and at the external end of the truncature. In *C. lampriodes* there is no sutural truncature, the apical margin being oblique and slightly flexuous from the sutural spine.

The basal margin of the elytra in *C. lampriodes* is red, the deflexed lateral margin purplish black; the surface of the elytra in all the numerous examples is of a beautiful dark blue, the rest of the insect immaculate testaceous red.

Lebia bipars, Walker (Ann. & Mag. Nat. Hist. 1858, ii. p. 203), is a *Colpodes* very similar in form to the present; the *black* elytra, as described by the author, appear to be the result of discoloration, although the surface in the type specimen is glossy and appears clean. Walker's specific name, I think, should not in any case be adopted, as it is impossible to identify the species from his erroneous description.

Colpodes retusus.

Piceo-niger; antennis, palpis, thoracis margine pedibusque dilutioribus; capite mox pone oculos magnos angustato; thorace relative parvo, quadrato, antice leviter rotundato-dilatato, postice paullo sinuato-angustato, angulis posticis rectis, margine laterali explanato-reflexo; elytris sat late oblongis, apice oblique sinuatis inermibus, dorso utrinque ante medium depresso punctulato-striato, interstitiis planis, tertio tripunctato.

Long. 8–11 lin.

Kandy.

Belongs to the group of Chaudoir's Division III. in which the four hinder tarsi are bisulcate with the space between the sulci carinate, the fourth joint unilobular, and the sutural apex of the elytra unarmed. The two anterior tarsi have only a very faint trace of sulci; the four hinder tarsi are slender.

Colpodes repletus.

C. lampros proxime affinis, differt thorace multo latiore. Rufo-testaceus; capite thoracisque disco castaneo-nigris; elytris (margine excepto) olivaceo-æneis; capite parvo, ovato, post oculos angustato; thorace transverso, lateribus arcuatis et late explanato-reflexis, angulis posticis obtusis, subrotundatis, basi utrinque profunde concavo, lævi; elytris apice ad suturam inermibus, extus sinuatis, dorso subpunctulato-striatis, interstitiis subplanis, tertio tripunctato.

Long. 8 millim.

Bogawantalawa.

Closely allied to the Japanese *C. lampros*, from which it

differs in the much broader thorax with sides more regularly arcuated, so that it is not narrower behind than in front, and by the duller and less golden-bronze colour of the elytra. All six tarsi have a fine sulcus on each side, and the fourth joint of the posterior pair is lobed on its outer side. The first elytral puncture is near the third stria, the second and third near the second stria.

Colpodes iteratus.

C. speculatori (Harold) affinis, differt tantum thorace angusto margine angustius explanato-reflexo et ante angulos posticos (valde obtusos) sinuato. Gracilis, rufo-testaceus, abdomine piceo, capite thoracisque disco nigris, nitidis; elytris olivaceo-æneis, margine testaceo; capite parvo mox post oculos citius angustato, oculis promiinulis; thorace anguste ovato vel leviter cordato; elytris anguste oblongis, postice paullo latioribus, apice inermibus leviter sinuatis, subpunctulato-striatis.

Long. 6-8 millim.

Dikoya and Nuwara Eliya, in wet places.

Belongs with *C. speculator* (Har.), *japonicus* (Motsch.), and *aurelius* (Bates) to a group of Chaudoir's Division III., distinguished by the hindmost tarsi having no groove on the *inner* side and their fourth joint being simply emarginated, not unilobular. In their colours they all resemble *C. lampros*, *C. modestior*, *C. sylphis*, and others, in which the same tarsi have a fine groove on each side (not visible viewed from above) and a unilobular fourth joint.

Subfamily PERIGONINÆ.

Perigona nigrifrons.

Nestra nigrifrons, Motschulsky, Etud. Ent. 1850, p. 38.

Bogawantalawa.

Perigona ruficollis.

Perigona ruficollis, Motschulsky, Bull. Mosc. 1851, iv. p. 506 (*Nestra ruficollis*); Putzeys, Ann. Mus. Civ. Genova, iv. p. 222.

Kandy.

The three dorsal setiferous punctures of the elytra in the examples which I refer to *P. ruficollis*, and which agree precisely in the described colours, are very conspicuous, and the third placed close to the apex. It varies in length from 3 to 3½ millim.

Perigona sinuaticollis.

P. ruficolli similis, sed differt thoracis lateribus postice valde sinuatis, angulis posticis rectis; rufo-testacea, capite nigro, elytris plaga

utrinque discoidali fusca (haud nigra) indistincte delimitata, vitta testacea, suturali, post medium dilatata, versus suturam late striatis, striis punctulatis sed paullo et vage impressis, punctis 3 dorsalibus setiferis vix perspicuis, tertio sat longe ab apice (sed haud valde distanti sicut in *P. nigrifronte*) apud interstitium tertium, secundo vero in stria secunda.

Long. $3\frac{1}{2}$–4 millim.

Dikoya.

Very similar to *P. ruficollis* in its general form, red-testaceous colour, and black head, but decidedly distinct in the longer and posteriorly sinuated thorax, in the lighter brown and less definite central portion of the elytra, and other characters.

Perigona fimicola.

Trechus fimicola, Wollaston, Ins. Maderens. p. 63: id. Col. Hesperid. p. 27 (*Trechichus*).

Colombo.

According to three specimens I have examined of this species, taken at the Cape-Verd Islands and named by Wollaston, the apex of the elytra is broadly black, the elytra have a silky subopalescent gloss, three (and not two as stated by Wollaston's original description) conspicuous dorsal setiferous punctures, the third very distant from the apex, and a faint dusky cloud or large oblong spot common to both elytra extending from the base to three fourths of their length. Mr. Lewis's specimens agree exactly in all these points and in structural characters with Wollaston's insect. The species seems to me also scarcely different from the North-American *P. nigriceps*, Dej. I should include also *Spathinus nigriceps*, Nietn., which is a *Perigona* or very nearly allied to it, if the author had not stated that the labrum is deeply emarginated, which it is not in *P. fimicola*.

Perigona Beccarii.

Perigona Beccarii, Putzeys, Ann. Mus. Civ. Genova, vii. p. 732?

Dikoya; abundant in refuse.

The insect referred to this species differs from *P. fimicola* only in colours, the large dorsal spot being darker and better defined against the lighter testaceous ground-colour of the elytra, which forms a submarginal vitta on each side, curving to the suture behind, between the dorsal spot and the black apex. This agrees with Putzeys' description of the Bornean *P. Beccarii*. On comparing a large number of examples I find, however, that the elytra of *P. Beccarii* are always smoother and glossier, the striæ still more feebly impressed or entirely invisible; the thorax, too, has rather straighter sides and more

distinct though obtuse hind angles, in some examples preceded by a slight sinuosity. In *P. fimicola* the sides fall obliquely to the obtuse hind angle.

Putzeys' description of the basal fold of the elytra is quite applicable to the Ceylonese specimens; but many of the other details given by him seem to me fanciful or inaccurate—that is, supposing the species are really the same. The following is evidently a colour variety:—

Var. *Perigona suffusa.*

Caput nigrum, thorax castaneo-rufus; elytra toto castaneo-fusca (apice nigra), vitta utrinque submarginali a basi usque prope apicem ibique intus curvata, pallido testacea.

The difference from the type form consists in the darker thorax and the extension of the large common spot of the elytra to the apex. It approaches very near *P. tachyoïdes*, Bates, which is, however, sufficiently distinct in the more tawny hue of the light parts and the more convex elytra.

Subfamily BEMBIDIINÆ.

Tachyta umbrosa.

Tachyta umbrosa, Motschulsky, Etud. Ent. 1862, p. 32,=*Acupalpus extremus*, Walker, Ann. & Mag. Nat. Hist. 1858, ii. p. 204?

Dikoya.

Very similar to the widely distributed *T. nana*, from which it differs only in the more strongly marked and punctulated elytral striæ, the posterior dorsal setiferous puncture situated in the fourth (instead of the third) stria, and in the lighter tawny testaceous antennæ. Several specimens agreeing with one from Kiu-Kiang on the Yang-tsze. It is probably the *Acupalpus extremus*, Walker, but only a fragment of Walker's type in the British Museum remains for comparison.

§ 1. TACHYS *proprie dictus.*

Tachys tropicus.

Bembidium tropicum, Nietner, Ann. & Mag. Nat. Hist. 1858, ii. p. 421.

Dikoya.

Tachys triangularis.

Bembidium triangulare, Nietner, Ann. & Mag. Nat. Hist. 1858, ii. p. 422.

Dikoya and Colombo.

Tachys subvittatus.

T. tropico et *T. triangulari* affinis, sed differt striis prope suturam utrinque 4 multo minus impressis, magis abbreviatis et inconspicue

punctulatis, punctoque dorsali anteriori extus ultra striam quartam sito; major, rufo-testaceus, elytris dorso depresso plaga elongato-ovata, suturali (a basi usque ultra medium) margineque laterali æneo-fuscis sericeis suffusis; thorace angulis posticis valde exstantibus, sulco basali lævi sed margine basali longitudinaliter striguloso.

Long. $3\frac{1}{4}$ millim.

Dikoya.

Very much larger than *T. triangularis* and differently coloured. Approaches much nearer *T. tropicus*, from which it differs chiefly in the feebler striæ and the situation of the anterior setiferous puncture, which is quite outside the fourth stria, on the smooth part of the elytron, and not in the fourth interstice as expressly stated by Nietner of *T. tropicus*, and as shown in the Ceylonese specimens referred to that species.

Tachys spilotus.

T. bistriato affinis, sed multo major elytrisque flavo-guttatis etc. Elongato-oblongo-ovatus, subdepressus, castaneo-niger subopalescenti nitens; antennis fuscis, articulis 1–3, palpis, pedibus elytrisque utrinque guttis parum distinctis duabus (prima subhumerali, secunda transversa ante apicem) flavo-testaceis; sulcis frontalibus brevibus, latis; thorace transversim quadrato, postice mediocriter angustato, angulis posticis rectis, margine basali, pedunculo et scutello testaceis; elytris utrinque striis 3 haud acute incisis, puncto dorsali in stria tertia sito.

Long. $2\frac{2}{3}$ millim.

Colombo.

Closely allied to the European *T. bistriatus*, but much larger, and the elytra more glossy and with slight opalescent reflections; the thorax is much broader and is differently formed near the hind angles, these being rectangular or even acute, and the hind margin from the angle to the slight median lobe being much less oblique. The single dorsal puncture is in the middle of the elytra; the second puncture, as in all the species of this section, lies within the apex of the recurrent striole.

Tachys atomarius.

Tachys atomarius, Wollaston, Col. Hesperidum, p. 28, = *Polyderis tenella*, Motsch. Etud. Ent. 1862, p. 35?

Bogawantalawa.

One example, exactly agreeing with a specimen named by Wollaston from the Cape-Verd Islands. The recurved striole is wanting, or, what seems more likely, removed nearer to the

lateral apical margin; the usual setiferous puncture exists, however, near its normal position in the typical group of the genus, *i. e.* where the curved apex of the recurved striole should be.

Tachyta microscopica, Bates, from Japan, agrees in all essential points of structure with *T. atomarius*, and is scarcely more than a geographical variety of the same. *T. livida*, Bates, an Australian species, is a more distinct species of the same group.

§ 2. Subgen. BARYTACHYS (Chaudoir).

Tachys bioculatus.

Tachys bioculatus, Putzeys, Ann. Mus. Civ. Genova, 1875, p. 743.

Abundant everywhere.

Tachys eucides.

Gracile ovatus, convexus, æneseenti-niger; elytris utrinque maculis rotundatis duabus rufis, altera subhumerali (interdum indistincta vel obsoleta), altera subapicali; antennis gracillimis, palpis pedibusque testaceo-flavis; fronte sulco utrinque angulato profundo et extus prope oculum foveola rotundata; thorace relative parvo, antice rotundato, prope basin constricto angulisque acutis; elytris striis utrinque prope suturam acutis impunctatisque.

Long. 3 millim.

Dikoya, abundant.

Differs from *T. bioculatus* and allies by the relatively small and narrow thorax, the basal furrow of which is crenulated and interrupted in the middle, as in the allied species. In all the numerous examples the antennæ and palpi as well as the legs are of a clear honey-yellow colour. The antennæ are long and slender and the joints two to five are nearly equal in length. There is no trace of a third elytral stria, and the two discoidal punctures are very conspicuous.

Tachys peryphinus.

Paullo magis oblongus et minus convexus, æneseenti-niger; elytris utrinque maculis duabus (vix distinctis et interdum obsoletis), altera subhumerali alteraque subapicali, rufis; antennis palpisque articulo penultimo nigro-fuscis, illis articulis 1–3, his basi pedibusque melleo-flavis; fronte utrinque sulcis brevibus duobus; thorace sat lato rotundato-cordato, basi sinuato-angustato, angulis posticis acutis; elytris utrinque striis 1–2 profunde insculptis et punctulatis, striisque tertia et quarta certo situ conspicuis, punctis duobus dorsalibus in stria tertia sitis.

Long. 3 millim.

Kitugalle, on the river-side.

In form of body similar to *T. Lucasi* (Duval), but the

thorax is a little longer and less transverse than in that species, and the third stria is not so sharply incised. The general colour is pitchy black or dark castaneous with a strong brassy tinge. The basal sulcus of the thorax is faintly crenulated as in the allied East-Asiatic species, and interrupted in the middle, where the deeply impressed termination of the dorsal line forms a distinct fovea. The red spots of the elytra are not sharply defined on their borders and cannot be called "round;" they are sometimes very small or disappear altogether.

Tachys ornatus.

Bembidium ornatum, Nietner, Ann. & Mag. Nat. Hist. 1858, ii. p. 426.

Kandy.

Specimens taken by Mr. Lewis agree with Nietner's description, except that the yellow elytral spots are not "orbicular," but (especially the posterior one) transverse. The forehead has two short parallel furrows on each side, and the elytra have no trace of striæ between the second (from the suture) and the eighth.

Putzeys's redescription (Ann. Mus. Civ. Genova, 1875, p. 21), in which he says "antennarum basi testaceis," cannot apply to Nietner's *B. ornatum*, which has uniformly pale antennæ and palpi.

T. pœcilopterus (Bates), from Fu-chau, is closely allied to *T. ornatus* and *T. scydmænoïdes*, but it is rather larger and sufficiently distinct from both in the form of the thorax.

Tachys scydmænoïdes.

Bembidium scydmænoides, Nietner, Ann. & Mag. Nat. Hist. 1858, ii. p. 427.

Colombo.

The sides of the thorax are sinuate-angustate from the middle to the basal angles (making the base "fortius quadrato," as Nietner expresses it), the frontal furrows are broad and deep, and the antennal joints from the fourth more or less dusky.

The size is, as in *T. ornatus*, 2 millim.

Tachys infans.

Parvus, oblongo-ovatus, mediocriter convexus, pallide testaceus; elytris medio vitta lata pallide fuscescenti; fronte utrinque sulco brevi unico.; thorace transverso, antice late rotundato, versus basin valde angustato, angulis posticis acutis; elytris utrinque striis punctulatis tribus, punctis 2 dorsalibus in stria tertia sitis.

Long. 2 millim.

Kandy.

Differs from other small pallid *Tachydes* in its more oblong and less convex form of body and the smaller thorax strongly narrowed towards the base. The elytra are flattened on the dorsal surface and the three punctured striæ on each side of the suture are somewhat sharply impressed with a very faint and short rudiment of a fourth stria. There are two strongly impressed marginal striæ on each side.

Tachys amplians.

T. globulo (Dej.) proximo affinis et simillimus; differt solum colore pallido testaceo striisque paullo distinctius punctulatis vel crenatis. Brevis, convexus, flavo-testaceus, antennis (articulis 1–2 exceptis) fuscescentibus; thorace valde transverso, lateribus versus basin sinuatis, angulis posticis subacutis; elytris stria suturali integra striisque 2–4 valde abbreviatis, parum incisis, crenulatis, stria marginali unica, puncto dorsali anteriore deficiente.

Long. 2 millim.

Kandy.

The elytra appear a little longer and more pointed at apex than in *T. globulus*. To this small group of *Tachys*, distinguished by the disappearance of the submarginal stria (the eighth), of which a few large punctures at the base and apex only remain, belongs also *T. perlutus* (Bates).

Tachys emarginatus.

Bembidium emarginatum, Nietner, Ann. & Mag. Nat. Hist. 1858, ii. p. 425.

Colombo.

Putzeys's description (Ann. Mus. Civ. Genova, 1875, p. 739) does not agree with Nietner's, nor with the numerous specimens taken by Mr. Lewis, as he gives the size as 1¼ millim. and states that the elytra have four red spots. The size is 2 millim. or a little longer (1 line, Nietner), and the elytra have only two subapical spots. The colour varies from pale testaceous, through castaneous, to bright pitchy black with an æneous tinge.

The species occurs in China (at Fu-chau and on the lower Yang-tsze Kiang) as a pale variety, exactly similar to the pale Ceylonese form, except that the lighter subapical spots are not quite so well defined; this is the insect alluded to as *T. scydmenoïdes*, Nietn., in Good. Col. Japan, Trans. Ent. Soc. 1873, p. 299.

Tachys Klugii.

Bembidium Klugii, Nietner, Ann. & Mag. Nat. Hist. 1858, ii. p. 423.

Colombo.

Tachys orientalis.

Bembidium orientale, Nietner, Ann. & Mag. Nat. Hist. 1858, ii. p. 425.

Colombo.

Tachys notaphoïdes.

Elongato-oblongo-ovatus, subdepressus, castaneo-fuscus vel rufus, ænescens; elytris utrinque maculis duabus transversis, pedibus antennarumque articulo primo (cæteris nigro-fuscis) flavo-testaceis; fronte utrinque bistriato; thorace quadrato, ante medium vix rotundato, postice parum angustato, angulis posticis rectis vel subacutis, margineque basali fere recto medio sinuato; elytris 9-striatis, septima fere obliterata, secunda ad sextam apice abbreviatis, octava et nona parallelis approximatis; punctis 2 dorsalibus apud interstitium tertium sitis.

Long. $2\frac{1}{2}$ millim.

Kitugalle, on the river-side.

Unlike any other species known to me. The elytral striæ are finely and sharply incised, the sixth being rather less deep and the seventh faint but distinct, the eighth runs throughout parallel to the ninth or marginal. The recurved striole is very deeply impressed, long and regularly curved. In these respects it differs from *T. orientalis* and *Klugii*, in which the eighth stria is much curved and recedes from the ninth in its middle course and the recurved striole is very short.

Bembidium europs.

B. nilotico proximo affinis, differt solum tegumento subtilissime alutaceo, subopaco, striisque frontalibus parum impressis, interruptis.

Long. $3\frac{2}{3}$ millim.

Kandy.

From *B. niloticum*, which has a wide range from Egypt to China and New Caledonia, and presents only trifling local modifications, the single example taken by Mr. Lewis differs in its finely shagreened surface, similar to that of many species of *Bracteon*. To this are added the much fainter frontal furrows, which, instead of being deep sulci, running (and diverging) from the epistome to the hind margin of the eyes, are faint and interrupted, and the space between them shows no convexity. The general colour is lighter brassy, and the testaceous spot at the apex of the elytra, instead of forming a large lunule on each side, is broken up into tesselated spots.

[To be continued.]

XV.—*Note on* Delias belladonna *of Fabricius*. By H. J. Elwes.

In the 'Annals' for January 1885 Mr. Butler has written on this species and described two new forms allied to it; but as his conclusions are, to my mind, quite erroneous, I should like to make some remarks upon them.

In the above instance it seems that Mr. Butler, having found, in a collection made by Mr. Horne in the North-west Provinces of India, a specimen of a *Delias* which in some points resembles Donovan's figure of *D. belladonna*, assumes that this form represents the type. He then goes on to say—"I think therefore that we may conclude that *Delias belladonna* is a species confined to the North-west Provinces, that *D Horsfieldii* is confined to Nepal, and that other forms allied to these may yet be expected to turn up." He then describes two forms which immediately did turn up as "sp. novæ," one from Barrackpore and the other from Darjiling. He concludes by saying that "females in this group appear to be very rare; of the four species here mentioned we only have male examples in the British Museum."

On reading this note I referred first of all to the British Museum collection and then to my own, hoping to get a better knowledge of this species; and I found that, as regards the two supposed new species, there is no good evidence as to their distinctness or habitat, but, further, that Donovan's figure does not represent exactly any Indian form of the species, that *D. Horsfieldii* is not confined to Nepal, and that Hewitson's collection does contain a female of one of the forms.

First as to the type of *belladonna*. It is clear that when a species varies extremely and the local varieties are not constant it is difficult, if not impossible, to fix the exact type of an old description of Fabricius, this difficulty being increased when we do not know whence the described insect came.

As, however, all the forms of this species are, so far as we know, confined in India to the Himalayas, and no collections from the Himalayas are known to have reached Europe in Fabricius's time, whereas many Chinese insects had been brought to Europe, it would be reasonable to suppose that if a form of *belladonna* occurs in China, and resembles Donovan's plate (which, however, in some respects is evidently inaccurate), the Chinese form would be most probably typical. When, therefore, I found in Dr. Staudinger's collection a specimen from China which did fairly agree with this plate, I

thought it was, to say the least of it, premature to conclude that the species was confined to the North-west Provinces, by which, in this case, I suppose Mr. Butler means the Himalayan provinces of Kumaon and Gurwhal. And I should here say that the form which he described as *D. ithiela* from Penang is only known from the Himalayas, and that if *D. Hearseyi* occurs at Barrackpore it was probably brought there from some Himalayan station, for there is no evidence that any form of this species occurs anywhere in the plains of Bengal or the North-west Provinces.

As my own collection is richer in this group than those under Mr. Butler's charge, I will here give the facts, so far as I can at present judge of them, supplementing them by a letter which I received from Mr. De Nicéville, of Calcutta, in answer to my inquiries on the subject.

I possess the following specimens, which appear to me to represent three distinct but closely allied and variable forms; but these may possibly be shown by increased material from Nepal and Western China to be undefinable, though typical specimens of the three races can be recognized.

Delias belladonna.

Delias belladonna, Fab. Ent. Syst. iii. p. 180 (1793); Don. Nat. Rep. i. t. xxxv. (1823).

I have one male, taken by Abbé David at Moupin or in some neighbouring locality in Western Szechuen, and one male from Tsekon, in East Tibet, received from M. Oberthür. The latter gentleman informs me that he has one male and one female from Moupin, two males from Tsekon, seven males from Attentse (E. Tibet), and one male and one female from E. Tibet, without precise locality; none of these individuals are, however, exactly like the figure in Donovan, and the two which I possess resemble so closely the figure of Gray (*Horsfieldii*) that I can see no reason to distinguish them.

If, therefore, any insect does exist which is distinct from the Himalayan *Horsfieldii* and like Donovan's plate, I should expect it to be found in the mountainous regions of South-western China, perhaps near Canton; but I am not able at present to see that there is sufficient evidence of such a fact, as the exact locality of Dr. Staudinger's specimen is uncertain and Donovan's plate is of doubtful accuracy.

Delias Horsfieldii.

Delias Horsfieldii, Gray, Zool. Misc. i. p. 32; Insects of Nepal, pl. viii. fig. 2.

= *D. Hearseyi* et *Boyleæ*, Butler, Ann. & Mag. Nat. Hist. 1885, xv. p. 58.

Var.? *ithiela*, Butler, Ann. & Mag. Nat. Hist. 1869, iv. p. 242.

Of this I have seven males, taken by my native collector in the interior of Sikkim, which are very black and represent *ithiela* of Butler; four of them have no yellow at all on the upper surface, three have more or less on both surfaces of the anal angle of the hind wings

Three males from Nepal, bought out of a large collection sent from Khatmandu, which agree with Gray's plate; also one specimen from Wilson's Darjiling collection, and one from the Abbé David, which come next and agree fairly in the amount of yellow on the hind wing. One from Nepal which has the least yellow comes very near that specimen of *ithiela* which has the most; but, like the Moupin and one other Nepal and one Sikkim specimen, these four are much browner in tint than the first seven specimens.

Four females from Wilson's Sikkim collection which may belong to the black *ithiela*, but are much nearer in tint to the browner Nepal and Moupin specimens. These agree in the shape of the fore wing, which is broader than in the males, but differ in the colour of the abdominal margin, which in one specimen is all black like the male *ithiela*, in one has a shade of yellow like some specimens of the same, and in the other two has more or less white on the upper surface, but is yellow like the others beneath.

Then I have six males and five females from the Mandra plateau, 8500 feet high, in Kulu, taken Sept. 3rd, and three males from Hocking's Kangra collection, which agree very fairly in general character, having more white on the wings than the Sikkim and Nepal specimens, and in the male an almost uniform amount of yellow on the abdominal margin. The females, which agree in having broader fore wings, are yellowish white or white on the abdominal margin. The palest of them differs little from the darkest of

Delias sanaca, Moore, Cat. Lep. E. I. Co. Mus. p. 79 (1857); P. Z. S. 1857, pl. xliv. fig. 4,

of which I have two males from Gurwhal (*Lidderdale*) and two males and one female from Simla (*Marshall*), taken in May. All these differ more or less, but agree in being generally paler than the Kulu specimens, which, again, are paler than those from Nepal, which are paler than the extreme black Sikkim males.

It seems as though some influence affected the coloration of the group, which is strongest in the warm damp climate of Sikkim, and becomes gradually fainter towards the north-west.

I could separate all these thirty-five specimens, of which

ten are female, into three forms; but until resident collectors have shown us whether these forms breed true to their type, and how far seasonal or climatic influences affect them, I cannot say that they are distinct species.

With regard to the habits of this species we know little or nothing; but I am informed by Captain Young that *D. sanaca*, or more probably *D. Horsfeldii*, is common in the Kangra valley, 3000 to 4000 ft. (probably its western limit), in April. In Kulu, at 3500 to 4000 ft., a few come out in April and May, and another brood in autumn. He has also taken it as high as 8500 ft. in September; but this is very unusual. The pupæ are grey and yellow and are attached to bare rocks.

Mr. Otto Möller says of *belladonna* and its allies, in a letter dated December 7, 1885:—"I believe them to be all only geographical varieties of one species. Both the form with and without yellow at the anal angle occur together here in Sikkim from 2000 to 9000 ft. I have only two females, one taken at 8000, the other at 9000 ft."

Mr. De Nicéville says, in a letter dated December 1, 1885:—"Mr. Butler states in his paper that Donovan's figure represents a male. I am of opinion, and Major Marshall concurs with me, that it is far more probably that of a female. The fore wing is broader than is usual among males of this group, and the outer margin of the wing evenly convex; in nearly all males it is more or less concave; the stoutness of the abdomen would also probably indicate a female *.

"In the Indian Museum, Calcutta, are six females of *D. belladonna*—one from Kulu (*Graham Young*), one from Kotghur, near Simla (*De Nicéville*), one from Simla (ditto), one from Dafla hills, and two without locality. The one from Dafla hills has no yellow whatever on the abdominal margin or at anal angle of hind wing; the former is sordid white: the Kulu and Kotghur specimens have a good deal of yellow mixed with white; the Simla example has the barest trace of yellow, the abdominal area being nearly pure white; the two without locality have very large patches of chrome-yellow (in the others the yellow is of a more clear gamboge shade) at the anal angle extending to first median interspace. These latter agree best with Donovan's figure, which, however, differs from all specimens I have seen in having two distinct well-separated spots on the submedian interspace; in all yellow-marked specimens there is a large undivided yellow streak between the veins from near the middle of the wing to the anal angle.

* The abdomen figured by Donovan is unlike any specimen I have seen and may not have belonged to the insect.

"*D. sanaca* seems a good species. I have one female from Fagu, near Simla (about 7000 to 8000 ft.).

"As regards the males, there is every variety from specimens with the abdominal area and anal angles entirely black, to others with the white and yellow extending as far as the median and postmedian veins. Mr. Möller tells me that he has taken both these forms in Sikkim in one sweep of the net; but, as far as my experience goes, the entirely black form never occurs in the N.W. Himalayas. My own idea is that there are three good species of this group:—*D. belladonna*, West China to Kulu; *D. sanaca*, Western Himalaya; *D. belucha*, Beluchistan.

"As to species of this group being found at Penang or Barrackpore, I should as soon expect to find wild zebras in those localities as examples of *Delias* allied to *belladonna*."

The evidence I have brought forward, based as it is on the examination of specimens ten times more numerous than Mr. Butler's and with authentic localities, and the opinions of three naturalists in India who know the species in life, seem to me so strong against every one of Mr. Butler's conclusions, that it is to be hoped he will in future refrain from adding to his very numerous and scattered writings of this character until he has ample material and accurate observations on which to base his opinions.

PROCEEDINGS OF LEARNED SOCIETIES.

DUBLIN MICROSCOPICAL CLUB.

January 18, 1885.

Irish Bog-butter.—Dr. Frazer directed the notice of the Club to the microscopic appearance of a specimen of bog-butter obtained in the form of a large irregular-shaped mass from Mouncha Bog, near Belfast. When examined in a molten condition it showed the cow's hairs so invariably detected in all the examples of Irish bog-butter yet investigated; and in this case there were also observed well-preserved fragments of *Sphagnum* moss in all portions of the fatty matter taken from the outer part of the mass. It was clearly entitled to be considered a true butter, and its sojourn in bog was evidenced by the coating of *Sphagnum*, now noticed for the first time.

A seemingly undescribed Phycochromaceous Alga from Pump-water.—Mr. Archer drew attention to an Algal production taken from the well of a pump, forming to the naked eye an appearance like ground coffee distributed pretty thickly in the water, the little bodies composing the mass being of a brownish mahogany-like colour. These, viewed under a moderate amplification, proved to

form reddish, variously lobed, more or less irregularly ramifying "shapeless" little masses. These were of some toughness and rigidity on pressure, so that it was not a little difficult to compress a portion for a closer examination. This accomplished, however, it was seen that the plant owed its brownish colour to the toughish lobed matrix, as described, in which were sparsely imbedded lines of minute spherical phycochromaceous cells of a light colour. Whether this may be regarded as a mature plant or only a "state" would seem as yet not very readily to be decided. It had clearly, however, nothing to do with the so-called *Bacterium rubescens* (Lankester). Were a minute *Polycoccus* pulled out here and there into a branched or lobed configuration, and the contained cells, instead of being in a single cluster, become run into lines following the prolongations, and supposing the containing matrix to assume a reddish colour, something like our plant would be the result.

Torula sporendonema and Cystopus candidus exhibited.—Mr. G. Pim showed *Torula sporendonema* (=*Sporendonema casei*) from some old cheese at the Albert Farm, Glasnevin. It is not uncommon on very old cheese, and seems to be a somewhat aberrant member of the genus *Torula*.

He also showed the young oospores of *Cystopus candidus*, the white rust so very common on the cabbage tribe. They were obtained by allowing diseased leaves to rot in a damp place.

Dermocarpa prasina, Bornet, *new to Ireland*.—Dr. M'Nab exhibited specimens of *Dermocarpa prasina*, Born. et Thur., collected at Seapoint, co. Dublin, in July 1875, attached to *Polysiphonia fastigiata*. This species has not as yet been recorded from Ireland; but Mr. G. W. Traill (Proc. Roy. Dubl. Soc. n. s. vol iii. p. 291, 1882) mentions that *Dermocarpa prasina* occurs on *Catenella opuntia*, in the Firth of Forth, in the month of January.

Structure of Leaf of Byblis liniflora.—Dr. M'Nab also exhibited part of a leaf of *Byblis liniflora*, Salisb., a portion of a dried specimen collected by Robert Brown (Iter Austral. 1802–5). The leaf is covered with small, long-stalked glands. The glandular top consists of from eight to sixteen cells, and closely resembles that of the hairs of *Pinguicula vulgaris*. Drude, in his paper on Insectivorous Plants in Schenk's 'Botanik,' p. 119, mentions that *Byblis gigantea*, Lindl., has the long filiform leaves closely covered with very short-stalked, small digestive glands; so that *B. liniflora* differs in having very long-stalked, small digestive glands sparingly scattered over the surface of similar linear leaves.

March 19, 1885.

Chlorocladus australiensis exhibited.—Dr. E. Perceval Wright exhibited mountings of *Chlorocladus australiensis*, Sonder. This interesting green algal form, discovered by Edward Daemel at Cape York, Australia, had been described by Dr. W. Sonder. It appeared to be very rare, and Dr. Wright was indebted to Baron F. von Müller

for some specimens which had been gathered at Cape York in the autumn of 1884. It seemed to have affinities with *Dasycladus* and *Neomeris*, but differed from the former genus in its dichotomy, and from the latter in the want of a calcareous film and an investing membrane.

Peculiar adventitious or abnormal (?) Growth of Hair-like Filaments on Stems of Moss.—Mr. Archer drew attention to a remarkable fringe of reddish arborescent filaments growing on a moss (*Aulacamnion palustre*), given him by Mr. Pim, imparting to the plant a very curious and striking appearance. These filaments grew from the stem only, not from the leaves, and presented, at first sight, much the appearance of an algal parasite of some kind, densely coating the moss, and from the colour very conspicuous. A closer examination showed that this was an actual outgrowth from the moss itself, the primary joint of these, so to speak, adventitious hairs being simply cut off from one of the joints of the stem of the moss. This then grew up into a comparatively stout main stem, which gave off (somewhat *Cladophora*-fashion) multitudes of branches, continually growing more and more slender, so as to form a densely dendroid structure, the whole confusedly interlaced, the leaves of the moss more or less involved and covered by the thicket so produced. The reddish colour, like that of protonematous growths, was due to the cell-wall, the contents being chlorophyllaceous green; here, however, unlike a Protonema, the joints were not separated by oblique, but directly transverse, septa. The whole might lead to the assumption that the moss was giving rise to a kind of retrogressive growth, a kind of secondary "Protonema," which, if detached, and on a damp substratum, might give rise to a new moss.

Claviceps Wilsoni from Aberdeen exhibited.—Mr. Pim showed *Claviceps Wilsoni* sent to him by Mr. A. Stephen Wilson, of Aberdeen. This is an extremely distinct form of ergot, occurring on *Glyceria fluitans* near Aberdeen. The club, instead of being nearly globose, is long and clavate and has the perithecia external to it as pear-shaped sacs, instead of being sunk in the substance of the club. The asci and spores did not differ materially from those of the common form, which was shown for comparison.

Section of Macrocystis pyrifera.—Prof. M'Nab exhibited a transverse section of part of the thallus of *Macrocystis pyrifera* taken close to the base of the air-bladder, showing the peripheral series of gum-canals.

Nectria sinopica exhibited.—Mr. Pim showed *Nectria sinopica* on ivy, received from Rev. H. W. Lett, Lurgan. The circular cluster of somewhat flattened deep red perithecia, surrounded by the ruptured epidermis, formed an exceedingly pretty object by reflected light, reminding one of a basket of strawberries.

June 18, 1885.

Embryo Plantlets of Fucus.—Dr. M'Nab exhibited seedlings or more correctly, young embryo plants of *Fucus vesiculosus*. Linn

These were found in considerable numbers adhering to the outside of the conceptacular portion of the thallus. The embryos measured about $\frac{1}{250}$ inch, but some were as long as $\frac{1}{150}$ inch, and notched at the apex, where a few hairs also originated. The specimens were collected on the shore at Clontarf on the morning of the 18th June. It seems therefore that the young embryos adhere for a short time to the surface of the mature thallus after their escape from the conceptacle.

Olivine Dolerite.—Prof. Hull, F.R.S., exhibited a thin section of Olivine Dolerite from Ballentory, co. Antrim. This rock is very massive and is quarried by the Eglinton Mineral Company for paving sets. Under the 2-inch objective it is seen to consist of plagioclase, augite, olivine, and titaniferous magnetite, the last not abundant. The effect with the polariscope is very fine, the olivine being fresh and polarizing vividly.

Young Parasitic State of Halcampa.—Prof. A. C. Haddon exhibited a living immature sea-anemone which was parasitic on Hydromedusæ. It was a still younger example than that described by Reid as *Halcampa Fultoni,* which Prof. Haddon believed was the young form of *Halcampa chrysanthellum*, Peach. Recently Mark has described the young of an *Edwardsia* as parasitic on the ctenophore *Mnemiopsis Leidyi*, so there is nothing unique in the parasitic habits of a larval sea-anemone.

Continuity of Protoplasm in Fucus.—Mr. Greenwood Pim exhibited sections of *Fucus vesiculosus* in which the continuity of the protoplasm from one cell to another was clearly shown. The sections were prepared in accordance with Dr. Hicks's directions in the April number of the 'Journal of Botany'—soaked in sulphuric acid and water (1 : 3), stained with saffranin, and mounted either in pure glycerine or glycerine and ammonia.

Zygospore of Cosmarium corbula, Bréb.—Mr. Archer showed the zygospore of *Cosmarium corbula*, Bréb., orbicular, and beset with rather numerous, elongate, slender spines, trifid at apex; this is rather a rare species, and still more rarely found conjugated.

October 15, 1885.

Rhizopodal Parasite (?) in a Sponge.—Prof. Sollas exhibited a section of a sponge having imbedded therein, seemingly occupying a cavity, an orbicular body, presenting many features giving it a strong resemblance to some rhizopodal form, showing what appeared to be a median nucleus and seemingly elongate pseudopodia. It did not seem to offer a resemblance to any state of an ovum.

Gloiotrichia natans exhibited.—Prof. M'Nab exhibited examples of *Gloiotrichia natans* which had developed in quantity in one of the tanks in the College of Science amongst plants which had been brought in June from the pond in the Botanic Gardens, Glasnevin.

Type of a new Alcyonarian Genus: Primnoides.—Dr. E. P. Wright exhibited mounted specimens of a small portion of the colony of a Primnoid Alcyonarian, for which a new genus, *Primnoides*, had to be made. The spicules of the cœnenchyma were small, orbicular, scale-like, gradually merging into those of the body of the polyp. There were no true opercular scales, but the tentacles were retractile. The species, one of the 'Challenger' collection, and called from its outline *P. sertularia*, W. & S., was dredged from a depth of 310 fathoms off Prince Edward Island.

Continuity of Protoplasm in Strychnos.—Mr. Greenwood Pim showed sections of *Strychnos ignatia* which had been treated with alcohol and iodine, as recommended by Mr. S. Le M. Moore, and which showed very distinctly the continuity of the protoplasm between one end of the endosperm and another. A section of *S. nux vomica*, in which the continuity was originally described by Dr. Tangl, was shown for comparison. The protoplasm-threads are much less easily seen in this species than in *S. ignatia*.

New Gregarious Monad.—Mr. Archer showed examples, unfortunately much deteriorated, which he put up on a slide in acetate of potash, of an organism sent him in very minute quantity by Prof. Lankester. This turned out (though somewhat algal-like at first glance) to be a form of gregarious monad, the individual monads nestling in a muco-granular coloured matrix. This matrix formed very minute subglobose masses, the basic substance of great rigidity and elasticity withal. So great was its retrogressive power on being pressed out with some considerable force, that, on its relaxation, it could forthwith pull itself together and restore its figure as if nothing had happened. However, on patiently causing the ejection of a few of the monads, they were seen to be elongate, minute, somewhat greenish in colour, with a narrow pale space at the anterior extremity, and occasionally, after a little wriggling action, they would swim away. But Mr. Archer had found it impossible actually to detect flagella, still less whether two or one only. Flagellate certainly these little organisms were, nevertheless, and the place of the form would therefore be close to such genera as *Spongomonas* or *Phalansterium*. Prof. Lankester was about to subject this organism to a closer study, and hoped to give an account of it ere long.

November 18, 1885.

Seeds of Lolium perenne and Festuca pratensis exhibited.—Dr. M'Nab exhibited under a low power with a binocular microscope seeds of *Lolium perenne* and *Festuca pratensis* for the purpose of directing attention to their special diagnostic characters and also for the purpose of demonstrating the use of Van Heurck's Helot photophore and the electric light in microscopical research.

Spumaria alba accompanied by a remarkable Network of Crystals

of Carbonate of Lime.—Mr. G. Pim exhibited specimens of *Spumaria alba*, which appears to be unusually abundant this year, as he has received it from Dr. E. P. Wright and Mr. R. M. Barrington, Fassaroe, and had heard of it from near Gorey, &c. The chief point to which attention was directed was the remarkable incrustation of carbonate of lime, consisting of exceedingly minute needle-shaped crystals which, lying very frequently more or less at right angles to each other, gave a somewhat cruciform appearance, and were collected into dense matted tufts. Some doubt existing as to the substance being carbonate of lime, Mr. Pim subsequently carefully tested it with acetic acid and oxalate of ammonia, with which it gave the characteristic reaction. The needles seldom exceed ·0005 in length by ·0001 in width, and are often much less.

Transverse Sections of Halcampa chrysanthellum were exhibited by Prof. Haddon illustrating the arrangement of the muscular bands of the twelve mesenteries, and demonstrating the existence of a pair of very small secondary mesenteries in the alternate mesenterial chambers. The œsophagus is ciliated, there are a pair of deep sagittal œsophageal grooves, which are provided with long cilia, and five obscure lateral furrows.

New Alcyonaria.—Dr. E. Perceval Wright exhibited a series of sections through the polyp (decalcified) of *Callozostron mirabile*, showing the absence of any marked siphonoglyph, the peculiar unfolding of the tentacles, and, at the base of the polyp, the ramifying network of vascular canals.—He further exhibited mounted sections of a new genus and species of the group of the Isidæ, in which the external spicules were like those of a *Primnoa*. The colony formed a reticulated network. The branches started from the hard joints, and these in the younger twigs were very beautifully ornamented with rows of irregular spine-like processes. The soft joints were very small. The species stands as *Acanthoisis flabellum*, Wright et Studer.

Micrococcus form (?) *on Piper-leaves.*—Mr. Archer exhibited some *Piper*-leaves (given him by Mr. Pim) showing on their lower surface what appeared to be a form of *Micrococcus*, forming here and there a thin scurfy stratum. If this were referable to that genus it would be a somewhat singular *nidus*. The leaves did not appear to be injured.

MISCELLANEOUS.

Notes on the Stomatopoda. By W. K. Brooks.

Two species of Stomatopoda are common at Beaufort—*Squilla empusa* and *Lysiosquilla* which, so far as I am aware, has never been described. The swimming-larvæ of both species are very

abundant, but I have not succeeded in obtaining the eggs, nor was I able to keep the younger larvæ alive in confinement, as they all died in moulting, although the older larvæ moulted in aquaria. I was therefore compelled to rely upon general resemblances and measurements in my attempts to trace the metamorphosis, although the series were so complete that I believe my results are worthy of confidence.

The youngest *Lysiosquilla* larvæ were in the same stage as Claus's larva. This stage is followed by an *Erichthus* stage, which persists for a number of moults with little change except the increase in size and the gradual acquisition of the appendages.

I have witnessed the change from the last form of this series into the young *Lysiosquilla*; so it is now certain that the *Erichthus* type is the larva of this genus, although it is of course possible that other genera may pass through the same larval stages.

As secondary sexual characters are rare among the higher Crustacea, it is interesting to note that the female *Lysiosquilla* is much larger than the male and of quite a different colour. Fully grown males are from 1½ to 2 inches in length, while the females are from 3 to 4 inches long. The males are of a grey colour and quite transparent, while the females are more opaque and of a dark olive-green colour, nearly black.

The habits of our two species are quite different. *Lysiosquilla* lives in pure sea-sand on beaches which are directly exposed to the ocean swell, and it is very abundant on Bird Shoal and on the sea-beach at Fort Macon. It lives in a deep cylindrical vertical burrow, which goes down for several feet, and it is almost impossible to procure the animals by digging. The males and females inhabit different burrows, and they lie in wait for prey at the top, which is arched over with sand, so that only the eyes of the animal are exposed. When suitable prey comes within reach they dart out so quickly that the eye can scarcely follow the motion, and, seizing the prey in their large claws, they instantly retreat to the bottom of the burrow, where the food is stored away, and the animal returns to the mouth of the burrow to resume its watch. They seldom venture more than 3 or 4 inches from the burrow; and I have obtained only one specimen which was captured in the water, although the trawl often brings up an abundant supply of the much larger *Squilla empusa*.

In constructing its burrow, *Lysiosquilla* brings up the sand from the bottom by armfuls, which are carried between the large claws to the mouth of the hole, to be deposited as far away as the animal can reach without leaving its burrow.

The burrows are so deep that digging for the animals is almost useless; and after many unsuccessful attempts to trap them, I found that it was easy to catch them by holding a piece of fish or crab near the mouth of the burrow as a bait with one hand, while the other hand was held ready to cut off the retreat into the burrow, by the use of a tin trowel. Their movements are so very quick that many escaped entirely, while others were cut in two by the trowel, although many were captured alive.

Squilla empusa lives in hard muddy bottom, in or on the sides of channels where there is a rapid current, and it constructs a shallow U-shaped burrow, open at both ends. The burrow is excavated by the current of water produced by the abdominal appendages, and I have never seen them carrying sand out of the holes. They do not arch over the opening, and they are often found swimming at a distance of many feet from the hole, probably in pursuit of prey.

Squilla stridulates by rubbing the serrated spine of the swimmeret across the serrated ridge on the ventral surface of the telson. The noise which is thus made under water can be clearly heard above the surface.—*Johns Hopkins University Circular*, Oct. 1885, p. 10.

On the Heart of the Gamasidæ *and its Significance in the Phylogenetic Consideration of the Acarida and Arachnoidea, and the Classification of the Arthropoda.* By Prof. CARL CLAUS.

The heart, discovered by M. Willibald Winkler, which has hitherto remained entirely unknown in the group Acarida, occurs in the posterior region of the body and above the rectum; it pulsates strongly and rapidly. It is remarkably like the heart of the Daphnidæ, and like this is reduced to a single chamber, which is perforated on each side by a fissure furnished with lip-like valves and passes anteriorly into an elongated median aorta. The position towards the posterior end of the body, which is rather surprising at the first glance, is explained by the simplification which the abdomen of the mite has undergone, appearing as a comparatively short unsegmented region, united without any demarcation with the cephalothorax. Hitherto the heart has been demonstrated only in *Gamasus*, and it is probable that its occurrence may be confined to only a few families of the Acarida, perhaps to the Gamasidæ alone. It is best seen in all its parts in the six-legged larvæ (probably of *Gamasus fucorum*, De G.), in which the integument is comparatively thin. These have probably never previously been examined in the living state under a high power, or the presence of the quickly pulsating heart could not easily have escaped observation. But even through the less transparent skin of the adult animal the heart is not difficult to recognize when one has seen it in the more delicate larva.

In the unilocular heart of *Gamasus* we have evidently to do with a retrograde organ. Just as Claus regarded the similar heart in the Cladocera as a secondary simplified form derived from the many-chambered heart of the Phyllopoda, this simple heart in the Mites, with its single pair of fissures, may be regarded as an abbreviated and rudimentary spider's heart, the latter being of elongated tubular form, with three pairs of fissures, and connected with a complex system of arterial vessels. And just as, among the Entomostraca, the unilocular heart of the Ostracoda and Copepoda occurs only in particular families of those orders and is altogether wanting in the lower groups, so in the Acarida the lower families, such as the

Dermaleichidæ, Tyroglyphidæ, and Sarcoptidæ, show no trace of the organ. Whether it occurs in the more highly organized tracheate families of the Acarida must be ascertained by further observations.

The interpretation of the unilocular hearts of the Entomostraca and Acarida as secondarily simplified forms agrees completely with the notion, founded upon many other considerations, that the Mites are degraded members of the class Arachnoidea, the starting-point of which must probably be sought in the great Palæozoic Gigantostraca with their resemblance to the Scorpions, hitherto regarded as Crustacea upon insufficient grounds. From the investigation of the development of living members of the group or nearly related types (*Xiphosura*, *Limulus*), although still imperfect, there seems to be more and more foundation for the opinion that these old Palæozoic types are morphologically much more nearly related to the Arachnoidea than to the Crustacea, although they have, in common with the latter, their aquatic habitat and, as a consequence, branchial respiration. Hitherto, evidently, far too much stress has been laid upon this last agreement in the division of the Arthropoda into Branchiata and Tracheata, without taking into consideration that the breathing by air-spaces may have been developed in different ways and at different times in the terrestrial forms, and that consequently no primarily decisive morphological value is to be ascribed even to the possession of *tracheæ*. Nevertheless the root of the old Gigantostraca and Xiphosura may have a common origin with the stem-forms of the Crustacea, the Protostraca. In the latter, besides the normal construction of the anterior head, the characteristic *Nauplius*-larva and the doubled number of pairs of antennæ may have prevailed throughout; while the former led up to a second great series of Arthropoda, characterized morphologically, in the first place, by the smaller development of the anterior head, and the *disappearance of the pair of members belonging to it, the anterior antennæ*, and further by the presence of six pairs of limbs on the fore body (cephalothorax), reduced to five pairs, however, in the Merostomata (? in all). Besides these two series of Arthropoda, probably united at the base, we have then, as forming a third series, the Insecta and Myriopoda, for the derivation of which the remarkable Annelid-like Onychophora (*Peripatus*) appear to be so significant.

The characters of the three Arthropod-series would then be as follows:—

Series I. (Crustacea.)—Two pairs of antennæ, the second of which represents the first pair of trunk-members removed forwards. A pair of mandibles as the second pair of trunk-members. Two pairs of maxillæ. Variety in the number and structure of the usually numerous pairs of limbs on the middle and hind body. Aquatic habitat and branchial respiration. *Nauplius-larva.*

Series II. (Gigantostraca, Arachnoidea.)—Absence of the anterior antennæ. One pair of limbs in front of the mouth (? belonging to the first or second body-metamere). Five, or sometimes four,

postoral pairs of limbs of the short stout cephalothorax. Respiration by branchiæ or tracheæ, sometimes leaflet-tracheæ.

Series III. (Onychophora, Myriopoda, Insecta.)—With an anterior pair of antennæ (representing the frontal tentacles of the Annelida) and a pair of mandibles (? representing the limbs of the first or second body-segment). Tracheal respiration.—*Anzeiger der kais. Akad. d. Wiss. in Wien*, December 17, 1885, pp. 250–253.

Virulence of the Common Parsnip.

Mr. Meehan referred to the deaths of some children at Danville, Pa., in the spring of 1884, reputed to be caused by eating the roots of the wild parsnip. This was usually understood to mean the roots of *Cicuta maculata* or, perhaps, *Conium maculatum*. Roots had been sent to him by the attendant physician among which was the fragment of a portion that one of the dead children had partially eaten, with teeth-marks on the remains. There seemed no chance of error in this case. The root, which was evidently neither of the two reputed to be virulent, was planted. It proved to be the true garden parsnip, *Pastinaca sativa*, which has become an escape from gardens in many parts of the United States. Although the evidence that the deaths were from the wild roots of the common garden parsnip appeared so conclusive, in view of the fact that there seems to be no record of such a virulent character in connexion with this plant, it was thought possible there might still be some mistake, and corroborative evidence was sought for. It was found that in the cultivated form some growers are careful about weeding or working among the leaves while the dew is on them, as severe cases of poisoning have been known to result; and on large seed-farms the workmen engaged in cutting the stalks at the seed-harvest have to protect their hands and arms against contact with the juices, or they are liable to be severely poisoned in a manner similar to that from the poison-vine, *Rhus toxicodendron*. With these facts it seems worth placing on record what seems to be indisputable, that the deaths of the Danville children was really caused by the wild garden parsnip, *Pastinaca sativa*.—*Proc. Acad. Nat. Sci. Philad.* 1885, p. 383.

Freshwater Sponges from Mexico. By Edward Potts.

Meyenia plumosa, Carter, var. *Palmeri*, n. var.

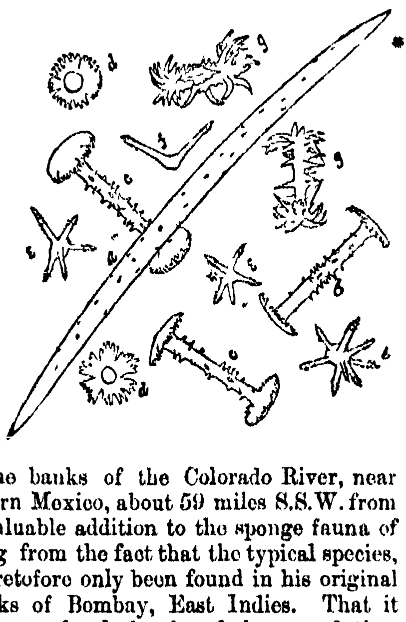
Sponge (as seen in a dry state) dark brown, massive, attached to and surrounding the dependent branches of small trees, whose stems are flooded by the spring freshets. Texture very loose, and when dry so brittle that the dermal surface cannot be satisfactorily examined. (The impression conveyed by the interior appearance of this sponge is that it is made up of an infinite number of radiating confluent branches.)

Gemmulæ large, numerous throughout the deeper portions of the sponge; subspherical or ovoid, surrounded by long birotulates imbedded in a granular crust.

Skeleton-spicules straight or slightly curved, mainly cylindrical, but gradually sharp-pointed, sparsely microspined.

Dermal spicules irregularly stellate, as in the typical species, but in the specimens examined much fewer in number. They vary from simple acerates with one or more long divergent branches to beautiful radiate spherical bodies whose rays are nearly equal, spined, and capitate by reason of recurved spines at their extremities. Another form of spicule, probably also dermal, of which several are seen upon nearly every slide prepared for microscopic examination, is very difficult of description. It may be said to be composed of an irregular series of smooth curved rays arising from a nearly common centre, and is somewhat suggestive of a hedgehog or Scotch terrier.

Birotulate spicules pertaining to the gemmulæ, in length about three times the diameter of the supported rotules; shafts cylindrical, plentifully spined; spines long, conical. Outer surface of rotules convex, margins lacinulate; ends of incomplete rays obtuse, recurved.



Sponge-masses subspherical, reaching 5 or 6 inches in diameter.

The woodcut represents: *a*, skeleton-spicules; *b*, *c*, *c*, birotulate spicules of the gemmule; *d*, *d*, ends or rotules of the same; *e*, *e*, *e*, *f*, dermal spicules; *g*, *g*, abnormal forms frequently observed. The spicules are magnified 200 diameters.

This sponge, collected by Dr. Edward Palmer along the banks of the Colorado River, near Lerdo, Sonora, in North-western Mexico, about 59 miles S.S.W. from Fort Yuma, California, is a valuable addition to the sponge fauna of this continent, and interesting from the fact that the typical species, *M. plumosa* of Carter, has heretofore only been found in his original locality, the rock water-tanks of Bombay, East Indies. That it should skip a whole hemisphere and only be found the second time at its own antipodes is indeed remarkable.

The lower reaches of the Colorado of the West extend for miles through a region described by the collector as the "hottest, driest, and most barren in the United States," whose "vegetation consists of mesquit, cacti, and the screw-bean, *Strombocarpus pubescens*." Its normal border-lands are known as the "first" and "second" "bottoms," of which the latter is the higher and, of course, more distant from the channel. By the frequent changes in its bed, however, the river cuts through these, and, washing away the one and filling up the other, reverses their physical conditions. Upon the

"second bottoms" then, said to be only reached to any considerable depth by the annual floods occurring during parts of May and June, and not to continue flooded more than six weeks at a time, the screw-bean abounds. It is described as a small tree of the general appearance of a peach-tree, but with more slender drooping branches. More or less of an alkaline deposit whitens the ground upon which they grow, and the approaching traveller is puzzled to see in strong contrast with it hundreds, or even thousands, of dark masses, "like wasps' nests," suspended two or three feet above.

It was this conundrum that confronted Dr. Palmer during his recent visit, and the answer we have is in the sponge before us. From the Amazon River in the tropics to the waters of Maine and Nova Scotia in the temperate regions of the north sponges have long been known to affect the pendent branches of stream-bordering bushes; but it is unlikely that they have ever before been observed in such quantities suspended for nine or ten months of the year over land parched and desolate.

On referring to Mr. Carter's earlier descriptions of his discoveries, we find that, though he collected this species on two or more occasions, the fragments were always found detached from their place of growth and floating upon the surface in the water-tanks referred to about one month after the rainy season had commenced. He believed that the vitality of the gemmules was preserved during the dry season notwithstanding their exposure to the sun and desiccating winds, and that their germination after the water had again reached them was followed by a very rapid growth of new sponge. This would seem to have been the case also with the present variety, as, according to the reports of the collector, the masses could not have been submerged for a greater period than six weeks in any one year. Whether the whole bulk as now seen was attained during a single season or is the cumulative result of several annual growths of the persistent masses cannot now be determined.

It is worthy of notice that *M. plumosa* and this variety, v. *Palmeri*, differ from all other known freshwater sponges by the presence in them of a compound or substellate dermal spicule. The spicules of the dermis throughout the group are generally minute spined acerates; in *M. Everetti*, Mills, we find them as minute birotulates. In *this* species the two forms seem to be combined; the spines have become central and prolonged, while their capitate extremities suggest the rotules of the last-named species.

Of the six sponge-masses from the above locality, sent by the Smithsonian Institution for examination, the smallest was somewhat fusiform in shape, and proved to belong to a different species—*Meyenia crateriformis*, Potts—heretofore found along the eastern border of the United States. In it alone the mass was not darkened by the presence of some pervading vegetable parasite.—*Proc. U. S. Nat. Mus.* 1885, p. 587.

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XVI.—*On the Tasmanian and Australian Species of the Genus* Stenopora, *Lonsdale*. By H. Alleyne Nicholson, M.D., D.Sc., Regius Professor of Natural History in the University of Aberdeen, and Robert Etheridge, Jun.

[Plates III. & IV.]

Some years ago the present writers gave an account of the structure of the corallum in the genus *Stenopora*, Lonsd. (Ann. & Mag. Nat. Hist. 1879, vol. iv. p. 265). In the same memoir two species of the genus were described and figured, one of these being identified (erroneously, as it proves) with *S. ovata*, Lonsd., while the second was characterized as new under the name of *S. Jackii*. Having now had the opportunity of examining in greater detail the collection of *Stenoporæ* in the British Museum, and also some interesting specimens which have been submitted to us by our friend Mr. R. L. Jack, we propose on the present occasion to shortly characterize all the well-defined species of the genus which are known to us as occurring in Tasmania and Australia.

Stenopora ovata, Lonsdale. (Pl. III. figs. 1-4.)

Stenopora ovata, Lonsd., in Darwin's Geol. Obs. Volc. Islands, p. 163 (1844), and in Strzelecki's Physical Description of New South Wales, p. 263, pl. viii. figs. 3 *a*, 3 *b* (1845).
(Non *Stenopora ovata*, Nich. & Eth., Jun., Ann. & Mag. Nat. Hist. 1879, vol. iv. p. 274.)

Spec. char. Corallum branched, of cylindrical or compressed stems, from 1½ to 3 centim. in diameter. The corallites diverge from a central line, or radiate nearly at right angles from both sides of a median plane. The corallites are long-oval, rounded or subpolygonal in shape, from ⅓ to ½ millim. in diameter, more or less. The walls are thickened, and show no clear line of demarcation between adjoining tubes. Tabulæ few and remote. Mural pores doubtfully detected. "Acanthopores" * are developed at the angles of junction of the corallites, but are comparatively few in number and of large size; they appear at the surface in the form of blunt spines. In the axis of the corallum the corallites are polygonal, but they become more or less cylindrical as they diverge outwards, and in the peripheral region they are annulated with numerous close-set periodical thickenings.

Obs. In our former memoir upon *Stenopora* (*loc. cit.*) we identified with the present species certain examples of a *Stenopora* which had been submitted to us by Mr. Jack, from the Permo-Carboniferous rocks of Queensland, and which we had carefully examined by means of thin sections. Our identification rested upon the fact that the specimens in question agreed entirely in external form and in macroscopic characters with the Strzeleckian type of *S. ovata*, Lonsd., preserved in the British Museum. We have, however, now been able to make a microscopic examination of thin sections of the type-specimen of *S. ovata*, and we find that in spite of the close external resemblance which it bears to the Queensland specimens, its minute structure is entirely different. The above definition of this species is therefore based upon the type-specimen of *S. ovata*, and not upon the Queensland examples,

* Most of the species of *Stenopora* are provided with the singular modified corallites for which the name of "acanthopores" has recently been proposed by Mr. A. H. Foord and one of the present writers (Ann. & Mag. Nat. Hist. ser. 5, vol. xvi. p. 497). These remarkable structures, formerly spoken of by one of us under the name of "spiniform corallites," are exceedingly characteristic of the Monticuliporoids. This fact, taken along with other marked resemblances between the *Stenoporæ* and certain of the Monticuliporoids, has led us to think that too great weight has perhaps been attached by De Koninck, as also by ourselves, to the value of the "mural pores" as a character of classificatory value. There can be no doubt that the walls of the corallites in some (and probably in all) of the species of *Stenoporæ* are pierced by irregular mural pores, and hence we have formerly referred the genus to the Favositidæ. In all other points except this the species of *Stenopora* are, however, most nearly related to the Monticuliporoids. The question therefore arises whether the *Stenoporæ* might not with propriety be regarded as an independent group of Corals (probably Alcyonarian), resembling the Monticuliporoids in their general characters, but having perforate walls.

and we shall describe these latter under the name of *S. australis*.

The character which distinguishes *S. ovata*, Lonsd., from all the other species of the genus is the presence of a single large acanthopore at most of the angles of junction of the corallites (Pl. III. figs. 1 and 3*). This character is specially noted by Lonsdale (Phys. Descript. N. S. Wales, p. 264), who mentions that there is only one "relatively large tubercle" in "the interspaces between four mouths;" whereas in *S. tasmaniensis*, Lonsd., each tube is encircled by a more or less complete ring of acanthopores. The acanthopores in *S. ovata* are not only few in number, but are of large size, with well-marked thickened walls. The corallites are mostly oval or subpolygonal, their walls completely amalgamated, and with but few and remote tabulæ. There is no evidence that the tabulæ were perforated by any central aperture. There is also no conclusive evidence as to the existence of mural pores, though there occur here and there in long sections rounded apertures which may very probably be of this nature (Pl. III. fig. 2, *p*). In the peripheral region of the corallum the corallites are furnished with regular and close-set periodical thickenings (Pl. III. figs. 2 and 4).

Locality and Horizon. The Strzeleckian type of *S. ovata* was found in the Permo-Carboniferous rocks of "Mount Wellington, Mount Dromedary, Norfolk Plains, Van Diemen's Land" (*Lonsdale*). In addition to the above-mentioned, the British Museum contains two examples from Tasmania, presented by Dr. J. Milligan. We have examined these microscopically, and find them not to differ essentially from the type-specimen (see Pl. III. figs. 3 and 4). The corallum, however, is more compressed, the corallites radiate from both sides of a central plane, and the acanthopores are relatively smaller than in the type, while the corallites themselves are also not so large. It would not appear, however, that these differences are of specific importance. (*Coll.* Brit. Mus.)

Stenopora australis, Nich. & Eth., Jun.
(Pl. III. figs. 5 and 6.)

Stenopora ovata, Nich. & Eth., Jun., Ann. & Mag. Nat. Hist. 1879, vol. vi. p. 274, pl. xiv. figs. 1–1 *c*.

Spec. char. Corallum sublobate or submassive, of cylin-

* A tangential section of *Stenopora ovata*, Lonsd., showing the solitary acanthopores, was figured by one of us (Nicholson, Pal. Tab. Corals, p. 281) under the name of *S. tasmaniensis*, Lonsd. This section was taken, not from the Strzeleckian specimen, but from one of the examples presented to the British Museum by Dr. J. Milligan.

drical or flattened branches, which have a diameter of from less than 2 to more than 3 centim. Corallites approximately vertical in the centre of the branches, but finally bending outwards nearly at right angles. In the central portion of the corallum the tubes are thin-walled and polygonal; but in the peripheral part of their course they are annulated by periodical thickenings of the wall separated by unthickened segments, and they are here subpolygonal. The average diameter of the tubes is about $\frac{1}{3}$ millim. The tabulæ are few and remote, and for the most part placed at corresponding levels in contiguous tubes; they appear to be sometimes complete, but they seem at other times to be perforated by a central aperture. Acanthopores wanting.

Obs. As before mentioned, this species so closely resembles the Strzeleckian type of *S. ovata*, Lonsd., that we thought ourselves justified in placing it under the latter species. In its minute structure, however, it differs widely from *S. ovata*, and resembles no other species of the genus known to us. One of the most marked characters of *S. australis*, in which it seems to stand alone among the species of *Stenopora*, is the total absence of acanthopores (Pl. III. fig. 5). This character at once distinguishes the species from *S. ovata*, Lonsd. It agrees with the latter in the fact that the walls of contiguous corallites are completely amalgamated, the primordial wall only being visible in the axis of the branches, and also in the average size of the tubes; but the corallites are mostly more of a polygonal than of a simply rounded shape. As seen in longitudinal sections (Pl. III. fig. 6) the corallites are thickened periodically in the peripheral region of the corallum by very regular fusiform thickenings placed at corresponding levels in contiguous tubes, as are also the tabulæ. As seen in long sections the tabulæ appear to be complete; but as viewed in tangential sections appearances are seen which are difficult to explain except upon the supposition that the tabulæ are perforated by a central aperture (Pl. III. fig. 5). Thus in many of the corallites, as seen in tangential sections, we observe a broad ring of light-coloured sclerenchyma internal to the proper walls of the tube and enclosing a central rounded aperture. What this ring is, unless it be a perforated tabula, it is difficult to see; but there is the curious feature that it is usually separated from the true wall for a portion of its extent on one side of the tube.

In our former description of this species (*loc. cit.*) we described and figured the above-mentioned singular structures, but were unable to give any explanation of their nature, as we believed the tabulæ to be imperforate. We are obliged to

admit, however, that if this be their real nature they differ in some inexplicable points from ordinary perforated tabulæ. In *Stenopora Howsii*, Nich. ('Annals,' Nov. 1883, p. 285), the tabulæ are not only perforated by central apertures, but this fact is quite as easily recognizable in long sections as in tangential ones. In this form, however, the tabulæ are extremely numerous, and the state of preservation is also very good. Mr. John Young has proposed ('Annals,' Sept. 1883, p. 154) the generic name of *Tabulipora* for a coral allied to or identical with *Stenopora Howsii*. In all other respects, however, save as regards its perforated tabulæ, *S. Howsii* does not differ from the normal species of *Stenopora*. If no other species of *Stenopora* possessed perforated tabulæ, there would be ground for accepting *Tabulipora* as a subgenus of *Stenopora*, or perhaps as a distinct genus. If, on the other hand, the structures above described as occurring in *S. australis* are really perforated tabulæ, there does not seem to be any need for a special generic name. Moreover, it is only on the supposition that perforated tabulæ occur in the species of *Stenopora* generally that we can account for Lonsdale's assertion that the mouths of the corallites in this genus are "closed at the final period of growth." In most of the specimens we have examined (except *S. Howsii*) the surface is so badly preserved that the characters of the mouths of the tubes could not be accurately determined; and in some (such as *S. ovata*, Lonsd.), where the preservation of the surface was better, we have not been able to recognize any such closure of the mouths of the tubes*. In one of the figures, however, which Lonsdale gives of *S. tasmaniensis* (Phys. Descript. N. S. Wales, pl. viii. fig. 2 *b*), the structure in question is well shown, and it corresponds entirely with what is seen in portions of the surface of *S. Howsii*, where it is undoubtedly the result of the existence of perforated tabulæ. We have ourselves observed the same structure in a single specimen of *S. tasmaniensis*, and we give a figure of it here (Pl. III. fig 11). We are therefore disposed to believe that perforated tabulæ were generally, if not always, present in the species of *Stenopora*, but that they were only produced (except in *S. Howsii*) at the final period of the growth of the tubes, and that they were, with the above exception, very few in number. It should be borne in mind in this connexion that the state of preservation of almost all the Australian and Tasmanian specimens of *Stenopora* which have been examined by us is highly peculiar. They are not

* Lonsdale himself states that he failed to recognize the phenomenon here alluded to in the case of *S. ovata*.

only highly mineralized, but they mostly exhibit in thin sections certain anomalous features which need not be further particularized here, but which render their structure in many respects very difficult of interpretation. In order to show the peculiar state of preservation here referred to, we have figured some of the sections precisely as they appear under the microscope (Pl. III. figs. 5–8).

Locality and Formation. Permo-Carboniferous, Coral Creek, Bowen-River Coal-field, Queensland. (*Coll.* Geol. Survey, Queensland, and Brit. Mus.)

Stenopora tasmaniensis, Lonsdale. (Pl. III. figs. 9–12.)

Stenopora tasmaniensis, Lonsdale, in Darwin's Geol. Obs. Volc. Islands, p. 161 (1844); and in Strzelecki's Phys. Descript. N. S. Wales, p. 262, pl. viii. figs. 2–2 *c* (1845).

(Non *Stenopora tasmaniensis*, Nich. Pal. Tab. Corals, p. 281 (1879), figure only.)

Spec. char. Corallum branched, the cylindrical stems varying from 1 to 1½ centim. in diameter; rarely in the form of a thin flattened frond. In the branched specimens the corallites radiate from the central axis, the peripheral portion of the corallum (in which the tubes are specially thickened) being very narrow. In frondescent specimens the corallites diverge nearly rectangularly from both sides of a median plane, and the axial region of the corallum is non-existent. The annulations or periodical thickenings of the walls in the peripheral region are very wide and run into one another, thus becoming comparatively indistinct. The corallites are oval, about ⅓ millim. in their long diameter, arranged in slightly oblique rows, with their long axes corresponding with the long axis of the corallum. Acanthopores are very numerous, arranged like the tubes in slightly oblique longitudinal rows, and forming a more or less complete ring round each corallite. Superficially the acanthopores appear as rows of small tubercles or minute apertures surrounding the mouths of the tubes. Tabulæ are very sparingly developed and appear in long sections to be complete; but the mouths of the tubes are sometimes closed by perforated tabulæ. Mural pores not detected.

Obs. This species is at once recognized by its long oval calices arranged in oblique longitudinal rows and by the similarly arranged rows of acanthopores (Pl. III. figs. 9 and 11). It agrees with *S. ovata* in the complete amalgamation of the walls of the corallites, which show no traces of the primordial wall. Transverse sections of the cylindrical specimens are remarkable for the great width of the axial region

of the corallum, the corallites in this region being angular and exhibiting the primordial wall distinctly. Another characteristic feature is that the annular thickenings of the walls of the corallites in the peripheral region of the corallum are nearly continuous with one another (Pl. III. figs. 10 and 11), and are not separated by marked unthickened segments. Tabulæ, further, are very sparsely developed, and are often not recognizable at all. The mouths of the tubes, however, are sometimes partially closed by perforated diaphragms (Pl. III. figs. 11 and 12). These structures, as previously noted, can hardly be anything else than perforated tabulæ, produced at the final period of growth, and they have been well figured by Lonsdale (Phys. Descript. N. S. Wales, pl. viii. fig. 2 *b*). In longitudinal sections of the thickened peripheral region of the corallum the acanthopores are seen as conspicuous narrow tubes (Pl. III. figs. 10 and 11) running in the thickness of the walls.

Locality and Formation. The original specimen of *Stenopora tasmaniensis*, Lonsd., appears to have been lost, as is also the case with the Strzeleckian type of the species. The British Museum, however, contains several specimens which more or less clearly belong to this form, viz.:—(1) A number of dendroid examples in a greenish ashy-looking matrix from Harper's Hill, near Maitland, New South Wales. One of these specimens shows mural pores excellently. Thin sections of one of these specimens are here figured (Pl. III. figs. 9–11). (2) Two examples from Port Lowell, Tasmania, in a light shelly limestone. (3) A remarkable frondescent specimen, numbered 48,746, also from Tasmania. In this example the corallum is only 3 millim. in thickness, and consists of two layers of corallites springing from a median plane (Pl. III. fig. 12). (4) Two examples in a dark-coloured matrix, from Killymoon, near Fingal, Tasmania. (5) A large cylindrical branched stem, likewise from Tasmania, and resembling the figured Strzeleckian type in general aspect. In minute structure, however, the tubes of the peripheral region show annular thickenings separated by distinct unthickened segments, thus giving rise to corresponding appearances in the tangential section; and we are therefore not clear as to the identity of this specimen with *S. tasmaniensis*.

Stenopora Leichhardtii, n. sp. (Pl. III. figs. 7 and 8.)

Spec. char. Corallum dendroid, of cylindrical branching stems, which vary in diameter from less than a centimetre up to 1½ centim. The corallites in the centre of the branches

are nearly vertical, with comparatively thin walls, and polygonal in shape. In the peripheral region of the corallum the corallites bend outwards nearly at right angles to the axis, the walls becoming thickened and being entirely fused with one another, while the visceral chambers become oval or rounded. The periodical thickenings of the walls of the tubes in the final portions of their course are mostly long and fusiform, and are generally placed at corresponding levels in contiguous corallites. The average diameter of the corallites is about ¼ millim. In the walls of the corallites in the peripheral region acanthopores are developed in great numbers, their shape being usually oval or subangular, their size large, and their walls not specially or only slightly thickened. Tabulæ are very sparingly developed, and are only occasionally to be recognized at all.

Obs. In its general form this species closely resembles *S. ovata*, Lonsd., and the typical examples of *S. tasmaniensis*, Lonsd. From these two species, however, the present form is distinguished, among other characters, by the extraordinary abundance and large size of the acanthopores. *S. Howsii*, Nich., has also very numerous acanthopores, but these are for the most part very minute, and the annular thickenings of the wall are quite different, while the tabulæ are very numerous and are perforated. The acanthopores are best seen in tangential sections (Pl. III. fig. 7); but they are also well exhibited in sections of the peripheral region of the corallum, cutting the corallites longitudinally, in which they appear as delicate clear tubes running in the thickened walls of the corallites (Pl. III. fig. 8). Tabulæ are often not to be detected, and when present are very few in number. In tangential sections appearances are occasionally to be detected which may perhaps be caused by the existence of perforated tabulæ; but as the specimens are in a very peculiar condition of preservation this cannot be affirmed with certainty. None of our specimens exhibit the surface of the corallum, and we therefore do not know if the mouths of the corallites were closed at the final period of growth by the development of a perforated tabula, as seems to have been sometimes the case in *S. tasmaniensis*, Lonsd., and probably in *S. australis*, nobis.

Formation and Locality. The specimens of this form which we have examined are from a purplish ferrugino-micaceous rock, of Permo-Carboniferous age, from Pelican Creek, half a mile above Sonoma and Bowen-Road Crossing, Bowen-River Coal-field, North Queensland. (*Coll.* Geol. Survey, Queensland.)

Stenopora Jackii, Nich. & Eth., Jun.

Stenopora Jackii, Nich. & Eth., Jun., Ann. & Mag. Nat. Hist. 1879, vol. iv. p. 275, woodcut, fig. 1.

Obs. It is unnecessary for us to repeat the description of this form, as we have nothing fresh to add to the characters which we have previously (*loc. cit.*) given of it. We have examined some further material; but as the state of preservation of all the specimens we have seen is such as to forbid the preparation of thin sections, we have acquired no new knowledge as to its structure. The species is distinguished by the small size of its stems, the minuteness of the corallites, and the narrow and ring-like annulations of the tubes in the peripheral region of the corallum. It is also remarkable for the distinctness with which it exhibits minute irregularly distributed mural pores.

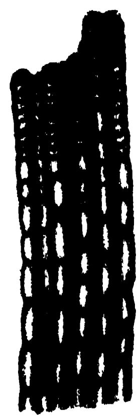
Formation and Locality. Permo-Carboniferous, Coral Creek, Bowen-River Coal-field, North Queensland. (*Coll.* Geol. Survey, Queensland, and Brit. Mus.)

Stenopora informis, Lonsdale.

Stenopora informis, Lonsdale, in Strzelecki's Phys. Descript. New South Wales, p. 264, pl. viii. figs. 4, 4 *a* (1845).

Obs. The figured type of this species, now in the British Museum, is a portion of a sublobate mass, preserved in a light brown rock, and itself silicified. It is about 2 inches wide and an inch or rather more in height, and its general appearance is very faithfully given in Lonsdale's figure (*loc. cit.*). The specimen comprises the *outer* portion of a large corallum, and shows that the tubes, which are approximately vertical in the centre of the mass, radiate outwards in all directions with a gentle inclination. In the deeper parts of the mass the tubes are in the main cylindrical, but are swollen at intervals, the swellings being of but small intensity and being placed at corresponding levels in contiguous tubes (woodcut, fig. 1). Hence the corallites are not in complete contact throughout, as is particularly well seen at the broken upper end of the specimen, where the tubes are fractured transversely. The growth of the corallum must have been periodic, as

Fig. 1.



A few of the tubes of *Stenopora informis*, Lonsd. (type-specimen), enlarged. (Drawn by Mr. A. H. Foord.)

the entire mass is stratified, each stratum being from 2 to 3 millim. in thickness. The diameter of the corallites is about one third of a millimetre. In the outer part of the corallum, when complete maturity has been attained, the corallites, still remaining cylindrical, become annulated with numerous well-marked and close-set rings of the regular Stenoporoid type.

We were at first disposed to think that *Stenopora informis* might be the *outer* portion of a massive *Stenopora*, of which *S. crinita*, Lonsd., constituted the central or *axial* portion. We have, however, abandoned this idea upon the ground that the tubes in the deepest parts of the type-specimen are always cylindrical, and are not in complete contact, whereas in *S. crinita* they are basaltiform and in contact throughout. Moreover the corallites in *S. informis* have a diameter of only about one third millim., but reach half a millim. or rather more in diameter in *S. crinita*.

Locality. Lonsdale gives "Spring Hill, Tasmania," as the locality from which the type-specimen was obtained. (*Coll.* Brit. Mus.)

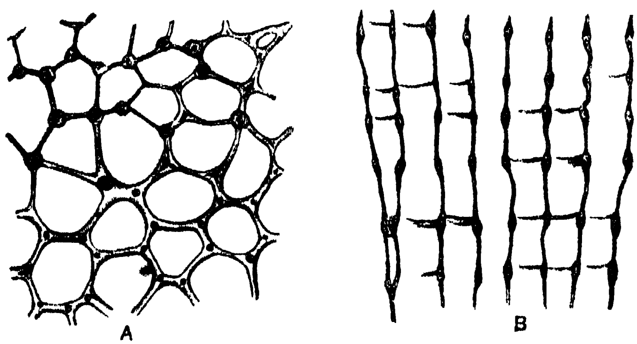
Stenopora crinita, Lonsdale. (Pl. IV. figs. 1–5.)

Stenopora crinita, Lonsdale, in Strzelecki's Phys. Descript. New South Wales, p. 265, pl. viii. figs. 5, 5 *a* (1845).

Spec. char. Corallum massive or sublobate, of long corallites which radiate outwards gently towards the surface. In the axial region of the corallum the corallites are basaltiform and in close contact throughout; but they become transversely wrinkled with narrow periodic annulations as they approach the final period of growth. The corallites are polygonal or subpolygonal, with comparatively thin walls, their average diameter being about half a millimetre. Acanthopores are developed at all the angles of junction of the corallites, and occasionally in other parts of the walls of the corallites. The walls of the corallites are periodically thickened by narrow ring-like annulations, which are found in all regions of the corallum, but are most abundant in the outer or peripheral zone. These annulations are comparatively wide apart, and are separated by long unthickened internodes, giving to longitudinal sections of the wall a characteristic moniliform aspect (woodcut, fig. 2). Tabulæ are very sparsely developed in the axial region of the corallum, but are comparatively numerous in the peripheral region, and correspond in general with the thickened segments of the corallites. So far as determined, the tabulæ are complete and imperforate. Surface not observed.

Obs. The type-specimen of *S. crinita*, Lonsd., now in the British Museum, is a large mass about 4½ inches in length and composed of long basaltiform corallites, which diverge from one another by the interpolation of new tubes with a very gentle outward inclination. The average diameter of the corallites is about half a millim., and they are polygonal in shape and in close contact throughout. The growth of the corallum was periodic, and the entire mass (as shown in Lonsdale's excellent figure) is stratified, the polygonal corallites showing a slight transverse wrinkling as they approach the upper surface of each successive stratum. It seems almost certain, however, that the type-specimen is only the central portion of a large corallum of which none of the outer portion is preserved; and there is therefore no reason to doubt that the corallites in the peripheral region of the corallum would exhibit the characteristic annulations of the genus.

Fig. 2.



Sections of *Stenopora crinita*, Lonsdale (M'Cormick collection), enlarged twelve times. A. Tangential section, passing in part through the thickened nodes and in part through the unthickened segments of the corallites: *a*, acanthopores. B. Vertical section, showing the bead-like periodic thickenings of the walls of the tubes and the tabulæ. Both sections show a dense brown-coloured irregular lining in all the tubes; but this seems to be clearly due to mineralization, and is omitted in the figure.

Indeed in other specimens which may be unhesitatingly identified with this species, and in which the external zone of the corallum is preserved, the corallites do actually show the periodic annulations which are found in all the other species of the genus.

Thin sections of such specimens, taken in the peripheral

region of the corallum, exhibit exceedingly characteristic appearances. In tangential sections (Pl. IV. fig. 4, and woodcut, fig. 2, A) the corallites are seen to be polygonal or subpolygonal in shape, and to be furnished with thin, completely amalgamated walls. The thickness of the walls varies according as the plane of the section corresponds with the thickened nodes of the walls or traverses the unthickened internodes (Pl. IV. fig. 4). At all the angles of junction of the corallites are placed well-marked acanthopores, which are sometimes minute, but at other times large, circular, thick-walled, and showing a distinct lumen (woodcut, fig. 2, A). In longitudinal sections (Pl. IV. fig. 5, and woodcut, fig. 2, B) the walls of the corallites are seen to be thin, but to be rendered moniliform by small fusiform thickenings which are placed at corresponding levels in all the tubes. Tabulæ are developed from these nodal points, but vary much in their numbers. Sometimes there are only very few of these structures, but at other times they may be developed from almost every successive pair of nodal points.

Thin sections of the type-specimen of *S. crinita* show phenomena which are at first sight strikingly unlike those exhibited by the specimens just alluded to. Thus in transverse sections of the type-specimen (Pl. IV. figs. 1 and 2) the corallites are seen to be polygonal and for the most part furnished with thin dark linear walls, at the angles of junction of which are placed small acanthopores. Here and there, however, at tolerably regular intervals, we observe groups of comparatively small-sized corallites, with thicker walls and larger acanthopores (Pl. IV. fig. 1). The peculiar feature of this specimen, however, lies in the fact that the thin proper walls of the corallites are uniformly lined by a continuous investment of brown calcareous substance of considerable thickness (Pl. IV. fig. 2). This investment is so invariably present, is so constant in its thickness, and so exceedingly regular in its development, that it has every appearance presented by the layer of secondary sclerenchyma which is deposited on the inside of the proper wall in *Pachypora*, *Laceripora*, and other similar corals. Precisely the same thing is exhibited by longitudinal sections of the type-specimen (Pl. IV. fig. 3), which show the proper moniliform walls of the corallites invested on both sides by the same dense and regular deposit. Our first impression therefore was that we had to deal here with a thick secondary investment of sclerenchyma, such as is found lining the visceral chambers in various types of tabulate corals. Further investigation, however, satisfied us that this view was untenable, and that this curious

investment, in spite of its extraordinarily regular development, is of inorganic origin, and is produced by a post-mortem deposition of carbonate of lime within the cavities of the tubes. We have been led to this conclusion principally by two considerations. In the first place we found that in one specimen of *S. crinita*, as above described, this secondary lining of the tubes had no existence at all (Pl. IV. fig. 4). In the second place we found that in another specimen of the same species this singular brown lining was present, but was irregular in its development, terminating in a ragged free edge where it surrounded the visceral chamber. We may therefore regard the figures in Pl. IV. as belonging to one and the same species—those of the type-specimen (figs. 1–3) having undergone this curious process of mineralization, while those of the specimen in the "M'Cormick collection" (figs. 4 and 5) are free from this. Such other differences as may be observed between these two sets of sections (apart from the absence or presence of this investment) are not only slight, but are easily explained by the fact that those of the type specimen are from the axis of the corallum, while those of the second set are from the peripheral region.

Formation and Locality. Permo-Carboniferous (?). The type-specimen is from Illawarra, New South Wales. In addition to the type-specimen the British Museum contains two specimens, in precisely the same state of preservation as the type, collected by Dr. M'Cormick during the voyage of the 'Erebus' and 'Terror' in either Tasmania or New South Wales. These specimens are distinctly sublobate in form, and it is from one of these that the sections represented in figs. 4 and 5, Pl. IV., have been taken. Other specimens of this species contained in the collection of the British Museum are as follows:—(1) Two specimens from Wollongong, New South Wales, one of which exhibits the characteristic nodular appearance presented by so many of the fossils of that locality. In all essential respects these specimens resemble the type-specimen, one being massive and the other sublobate. (2) Three silicified specimens, from Eaglehawk Neck, Tasmania. We have examined thin sections of one of these, and have little hesitation in identifying them with *S. crinita*; but their state of preservation is very poor. (3) A small silicified specimen, believed to be from Point Puer, Tasmania.

Stenopora? gracilis, Dana, sp.

Chætetes gracilis, Dana, Wilkes' U. S. Explor. Exped. vol. x. Geology (1849), p. 712, Atlas, t. ii. figs. 10, 10 *a–e*.

Spec. char. "Ramose, branches slender, 1½ to 3 lines

thick; cells sub-elliptical and having the border a little prominent. Columns of the size in the *ovata* (about six to a line in breadth), even, with few constrictions." (*Dana.*)

Obs. We have never been able to satisfactorily detect this species in any collection of Australian *Stenoporæ* yet examined by us. It appears, however, to be distinguished by the remarkable paucity of annular thickenings and constrictions, or, at times, their total absence. This feature has led us to even doubt if it be a *Stenopora*, although in general habit it bears a strong resemblance to the other previously-cited species.

Formation and Locality. Carboniferous?, Wollongong Point and Black Head, Illawarra, New South Wales (*Dana*).

Stenopora? sp.

Stenopora? sp., Nich. & Eth., Jun., Ann. & Mag. Nat. Hist. 1879, vol. iv. p. 276.

Obs. In our paper on the "Palæozoic Corals of Northern Queensland" we drew attention to what may prove to be another species of *Stenopora*. For further information we refer to our previous description, simply remarking that we are not at present in a position to offer additional particulars.

Formation and Locality. Carboniferous, Gympie, North Queensland. (*Coll.* Brit. Mus. and Geol. Survey, Queensland.)

EXPLANATION OF THE PLATES.

Plate III.

Fig. 1. Tangential section of the Strzeleckian type-specimen of *Stenopora ovata*, Lonsd., enlarged about twenty-four times.

Fig. 2. Longitudinal section of the same specimen, similarly enlarged. *p*, supposed mural pore.

Fig. 3. Tangential section of another specimen of *Stenopora ovata*, Lonsd. (from the Milligan collection), enlarged about twenty-four times.

Fig. 4. Vertical section of the same, similarly enlarged.

Fig. 5. Tangential section of *Stenopora australis*, Nich. & Eth., Jun., enlarged about twenty-four times.

Fig. 6. Vertical section of the same, similarly enlarged.

Fig. 7. Tangential section of *Stenopora Leichhardtii*, Nich. & Eth., Jun., enlarged about twenty-four times.

Fig. 8. Vertical section of the same, similarly enlarged.

Fig. 9. Tangential section of *Stenopora tasmaniensis*, Lonsd., enlarged about twenty-four times.

Fig. 10. Longitudinal section of a few of the tubes of the same, similarly enlarged. The section is taken from the outer part of a transverse slice.

Fig. 11. Mouths of some of the corallites of *S. tasmaniensis*, Lonsd.,

slightly enlarged, showing the spiniform terminations of the acanthopores and the perforated tabulæ closing the tube-mouths. (Copied from Lonsdale.)

Fig. 12. A few of the cell-mouths of *Stenopora tasmaniensis*, enlarged about twenty-four times. The acanthopores are seen, and some of the tube-mouths are furnished with a perforated tabula.

Fig. 13. Longitudinal section of a frondescent specimen of *S. tasmaniensis*, enlarged about twenty-four times.

PLATE IV.

Fig. 1. Transverse section of the type-specimen of *Stenopora crinita*, Lonsd., enlarged about twelve times.

Fig. 2. Part of the same section, enlarged about twenty-four times.

Fig. 3. Longitudinal section of the same, enlarged about twenty-four times *.

Fig. 4. Tangential section in the peripheral region of the corallum of another specimen of *S. crinita*, enlarged about twenty-four times. The section traverses in part the thickened portions of the corallites and in part the unthickened segments.

Fig. 5. Longitudinal section of the same specimen, enlarged about twenty-four times.

XVII.—*The Abyssal Decapod Crustacea of the 'Albatross' Dredgings in the North Atlantic* *. By SIDNEY I. SMITH.

THE most interesting feature of the Crustacea collected by the 'Albatross' is the great number of very deep-water or abyssal species of Decapoda obtained in a restricted region of the western North Atlantic. The whole number of species of true Decapoda dredged by the 'Albatross' is over 130; but nearly half of these are from shallow or comparatively shallow water. None of the shallow-water species were taken below 1000 fathoms, and it is perhaps best to limit the abyssal fauna to depths greater than this, although some true deep-water species are excluded by adopting so great a depth. Taking this limit strictly we have 44 abyssal species, as shown in the following:—

* This article is in the main abstracted from the introductory portion of the author's "Report on the Decapod Crustacea of the 'Albatross' Dredgings off the East Coast of the United States during the Summer and Autumn of 1884," with twenty plates, recently presented to the U.S. Commissioner of Fish and Fisheries, by whose permission it is here published in advance of the Government report. The collections made by the 'Albatross' in the West-Indian region during the winters of 1884 and 1885 are not referred to in this article, which applies exclusively to the region north of Cape Hatteras; but some of the results of a partial examination of the collections made in the summer of 1885 are included.

List of Decapoda taken below 1000 Fathoms in the North Atlantic by the 'Albatross' in 1883–85, with the Bathymetrical Range of each Species.

BRACHYURA.

Cancroidea.

	faths.
1. Geryon quinquedens, *Smith*	105 to 1081

Dorippoidea.

2. Ethusina abyssicola, *Smith*	1497 to 2221

ANOMURA.

Lithodoidea.

3. Lithodes Agassizii, *Smith*	410 to 1255

Paguroidea.

4. Parapagurus pilosimanus, *Smith*....	250 to 2221

Galatheoidea.

5. Munidopsis curvirostra, *Whiteaves*..	75 to 1290
6. —— crassa, *Smith*	1742 to 2020
7. —— similis, *Smith*	1060
8. —— Bairdii, *Smith*	1497 to 1742
9. —— rostrata (*A. M.-Edwards* sp.) .	1098 to 1356

MACRURA.

Eryontidæ.

10. Pentacheles sculptus, *Smith*	250 to 1081
11. —— nanus, *Smith*	705 to 1917
12. —— debilis, *Smith*	1290 to 1309

Crangonidæ.

13. Pontophilus abyssi, *Smith*	1917 to 2221

Glyphocrangonidæ.

14. Glyphocrangon sculptus, *Smith*	1006 to 1434
15. —— longirostris, *Smith*.	

Alpheidæ.

16. Bythocaris gracilis, *Smith*	888 to 1043
17. Heterocarpus oryx, *A. M.-Edwards*.	1081

Nematocarcinidæ.

18. Nematocarcinus ensiferus, *Smith* ..	588 to 2033

MIERSIIDÆ.

	faths.
19. Acanthephyra Agassizii, *Smith*	Surface * and 105 to 2949
20. ——, sp.	2069
21. —— microphthalma, *Smith*	2574 to 2620
22. —— brevirostris, *Smith*	1395 to 2949
23. —— gracilis, *Smith*	2512
24. Oplophorus, sp.	1356
25. Notostomus robustus, *Smith*	1309 to 1555
26. —— viscus, *Smith*	2949
27. Meningodora mollis, *Smith*	1106 to 1630
28. Hymenodora glacialis, *G. O. Sars*	2369 to 2949
29. —— gracilis, *Smith*	826 to 2949

PASIPHAIDÆ.

30. Pasiphaë princeps, *Smith*	444 to 1342
31. Parapasiphae sulcatifrons, *Smith*	516 to 2949
32. —— cristata, *Smith*	826 to 1628
33. —— compta, *Smith*	1537 to 2369

PENÆIDÆ.

34. Hymenopenæus microps, *Smith*	906 to 2620
35. Aristeus ? tridens, *Smith*	843 to 2620
36. Hepomadus tener, *Smith*	1209 to 2949
37. Amalopenæus elegans, *Smith*	445 to 2369
38. Benthœcetes Bartletti, *Smith*	578 to 1081
39. Benthonectes filipes, *Smith*	693 to 1043
40. Benthesicymus ? carinatus, *Smith*	1020
41. —— moratus, *Smith*	1537 to 1710

SERGESTIDÆ.

42. Sergestes arcticus, *Kröyer*	221 to 2516
43. —— robustus, *Smith*	500 to 2574
44. —— mollis, *Smith*	373 to 2949

The following species, though not yet recorded from below 1000 fathoms, might properly enough be added to this list, as they all undoubtedly extend below the 1000-fathom line:—

	faths.
45. Sclerocrangon Agassizii, *Smith*	390 to 959
46. Sabinea princeps, *Smith*	353 to 888
47. Nematocarcinus cursor, *A. M.-Edw.*	384 to 838
48. Acanthephyra eximia, *Smith*	938
49. Ephyrina Benedicti, *Smith*	959

* A small specimen, unquestionably of this species, was taken at the surface in a hand-net at 10.45 P.M., Aug. 11, 1884, north lat. 39° 35', west long. 71° 18' approximately. The specimen was kept alive for half an hour, and then placed in alcohol while still alive.

The first question which arises in discussing the bathymetrical habitats of the species in this list is: Which of them actually inhabited the bottom, or the region near the bottom, at the depths from which they are recorded, and what depths do the remaining species inhabit? That none of them are truly pelagic surface species may, I think, be taken for granted, for with the single exception of *Acanthephyra Agassizii* none of the free-swimming species have been taken anywhere near the surface.

The first fifteen species in the list, and 45 and 46 as well, are unquestionably inhabitants of the bottom, and never swim any great distance from it. Nos. 16, 17, 18, and 47, though species which may swim freely for considerable distances from the bottom, undoubtedly rest upon it a part of the time, the structure of the peræopods being fitted apparently to do this.

The species of *Acanthephyra*, *Oplophorus*, *Ephyrina*, *Notostomus*, *Meningodora*, and *Hymenodora*, which are very much alike in the structure of the articular appendages and branchiæ and are here grouped together as Miersiidæ, are among the most common and characteristic forms taken in trawling at great depths; and it is perhaps doubtful whether any of them are, strictly speaking, inhabitants of the bottom. The occurrence at the surface of a living and active specimen of *Acanthephyra Agassizii* shows that this species at least is capable of living at the surface in water of a temperature more than thirty degrees higher than that of the abyssal depths. Such facts make it very difficult to draw any conclusions from the mere finding of specimens of any free-swimming species in the trawl coming from particular depths, and we are compelled to resort to the structure of the animal itself for evidence as to the depth of its habitat. The highly-developed black eyes, the comparatively small eggs, and the firm integument of *Acanthephyra Agassizii* and *A. eximia* are some evidence, though perhaps inconclusive, that these species do not normally inhabit the greatest depths from which the former species has been recorded; and neither the length nor the structure of the peræopods shows special adaptation for resting on soft oozy bottoms. We are therefore led to conclude that these two species normally inhabit the upper part of the vast space between the surface and bottom regions. The similarity in the structure of the peræopods in all the species of the genus except *A. gracilis* apparently indicates similarity in habits; but the imperfectly developed eyes and soft integument of *A. microphthalma* and *A. brevirostris* are evidence that these species inhabit greater depths than *A. Agassizii* and *A. eximia*, and that they are truly abyssal if not bottom-

inhabiting species, and their absence from the trawl when coming from moderate depths, as shown in the records of their capture, helps to confirm this. The small number and great size of the eggs of *A. gracilis* would seem to indicate an abyssal habitat for that species also; but the large black eyes are probable evidence that it does not descend to the extreme depths inhabited by *A. microphthalma.*

Their similarity of structure makes it probable that the species of *Oplophorus*, *Ephyrina*, *Notostomus*, *Meningodora*, and *Hymenodora* are similar in habits to the species of *Acanthephyra*, and the structure of their eyes and integument, and the small number and great size of the eggs in the species in which they are known, as well as the records of their capture, indicate that they are all abyssal or at least deep-water species.

The form of the body and the structure of the peræopods of *Pasiphaë princeps* indicate that, like the other species of the genus, it is a free-swimming species, probably never resting on the bottom. It is probably neither a truly abyssal nor, judging from the size of the eggs as well as the records of its capture, a surface species. The structure of the eyes, the very small number and great size of the eggs, and the soft integument of the species of *Parapasiphaë*, render it probable that they are really abyssal species, though probably not confined to the immediate region of the bottom.

The eight species of Penæidæ in the list are undoubtedly all free-swimming forms not confined to the immediate region of the bottom; but, judging from the relatively small size of the eyes and the presence of well-developed ocular papillæ, they are all deep-water if not abyssal species.

The records of occurrence of the three species of *Sergestes* show that they are not confined to abyssal depths. The relatively small eyes and exceedingly soft integument of *S. mollis* would seem to indicate that it inhabited much greater depths than the other species; but the records of its capture afford no additional evidence of this.

We may then divide these species provisionally into the four following classes:—

I. *Species inhabiting the Bottom or its immediate Neighbourhood.*

Geryon quinquedens.	Munidopsis similis.
Ethusina abyssicola.	—— Bairdii.
Lithodes Agassizii.	—— rostrata.
Parapagurus pilosimanus.	Pentacheles scupltus.
Munidopsis curvirostra.	—— nanus.
—— crassa.	—— debilis.

Sclerocrangon Agassizii.
Pontophilus abyssi.
Sabinea princeps.
Glyphocrangon sculptus.
—— longirostris.
Bythocaris gracilis.
Heterocarpus oryx.
Nematocarcinus ensiferus.
—— cursor.

II. *Species probably not confined to the immediate Neighbourhood of the Bottom, but showing structural evidence of inhabiting Abyssal Depths.*

Acanthephyra microphthalma.
—— brevirostris.
Oplophorus, sp.
Notostomus robustus.
—— viscus.
Meningodora mollis.
Hymenodora glacialis.
—— gracilis.
Parapasiphae sulcatifrons.
—— cristata.
—— compta.

III. *Doubtful, but probably inhabiting Abyssal Depths.*

Acanthephyra gracilis.
Ephyrina Benedicti.
Hymenopenæus microps.
Aristeus? tridens.
Hepomadus tener.
Amalopenæus elegans.
Benthœcetes Bartletti.
Benthonectes filipes.
Benthesicymus? carinatus
—— moratus.
Sergestes mollis.

IV. *Species probably not inhabiting Abyssal Depths.*

Acanthephyra Agassizii.
—— eximia.
——, sp.
Pasiphaë princeps.
Sergestes arcticus.
—— robustus.

Summing up these lists according to the greatest depths from which the species are recorded, we have the following:—

Class.	Abyssal.	Below 1000 faths.	Below 2000 faths.
I. From the neighbourhood of the bottom	21	18	5
II. Abyssal, but not confined to the bottom.	11	11	7
III. Doubtful, but probably abyssal	11	10	6
IV. Probably not abyssal..	6	5	4
Total	49	44	22

The great differences in depth through which some of the species, unquestionably inhabiting the region of the bottom,

are recorded as ranging is worthy of notice. Of the 18 inhabitants of the neighbourhood of the bottom which are recorded as taken below 1000 fathoms, 9 have a recorded range of over 800 fathoms, and one of them, *Parapagurus pilosimanus*, of nearly 2000 fathoms. The case of the *Parapagurus* is very remarkable. It was taken at fifteen stations and in from 250 to 640 fathoms by the 'Fish Hawk' and 'Blake' in 1880–82, and in great abundance at one station in 319 fathoms, where nearly four hundred large specimens were taken at once. All these earlier specimens were inhabiting carcinœcia of *Epizoanthus paguriphilus*.

In the 'Albatross' dredgings of 1883–85 it was taken at twenty-one stations, ranging in depth from 353 to 2221 fathoms; but at fourteen of these stations, all of which were below 1500 fathoms, none of the specimens were associated with the same species of *Epizoanthus*, some of them being in *Epizoanthus abyssorum*, others in naked gastropod shells, and others still in an actinian polyp, apparently the *Urticina consors*, Verrill, which often serves for the carcinœcium of *Sympagurus pictus* from 164 to 264 fathoms.

The large size of many of the species is very remarkable, but no more so than the apparent absence of all very small species of Decapoda from the abyssal fauna. Of the forty-nine species enumerated above, not one can be considered small for the group to which it belongs, while more than a dozen of them are very large. *Geryon quinquedens* is one of the largest Brachyurans known, the carapace in some specimens being 5 inches long and 6 broad; specimens of the great spiny *Lithodes Agassizii* measure 7 inches in length and 6 in breadth of carapace, and the outstretched legs over 3 feet in extent; *Munidopsis crassa*, *Bairdii*, and *rostrata* are the three largest known species of Galatheidæ; *Sabinea princeps* reaches over 5 inches in length, and is probably the largest known Crangonid, though its size is very nearly equalled by the species of *Glyphocrangon*; *Notostomus robustus* is often 6 inches in length and very stout; *Pasiphaë princeps* attains a length of nearly 3 inches, and is a giant in the family to which it belongs; *Aristeus? tridens* equals a foot in length, and is but little larger than *Hepomadus tener*; and *Sergestes robustus* and *mollis* are apparently the largest known species of Sergestidæ.

The colour of the abyssal Decapoda is very characteristic. A few species are apparently nearly colourless; but the great majority are some shade of red or orange, and I have seen no evidence of any other bright colour. A few species from between 100 and 300 fathoms are conspicuously marked with

scarlet or vermilion; but such bright markings were not noticed in any species from below 1000 fathoms. Below this depth orange-red of varying intensity is apparently the most common colour, although in several species, very notably in *Notostomus robustus*, the colour is an exceedingly intense dark crimson.

The structure of the eyes of the abyssal Decapoda is of the highest interest, and worthy of the most minute and careful investigation and comparison with the corresponding structures of shallow-water species. Such an investigation I have not been able thus far to make; but the importance of the subject induces me to record the results of a superficial examination of the external characters of the eyes of most of the abyssal species from the 'Albatross' collections.

If we exclude from this examination all the species whose bathymetrical habitat is in any degree doubtful, and examine the twenty-one species given as inhabiting the immediate neighbourhood of the bottom, we find that *Geryon quinquedens*, *Lithodes Agassizii*, and *Sabinea princeps* have normal well-developed large black eyes, apparently entirely similar to those of the allied shallow-water species; *Sclerocrangon Agassizii*, *Bythocaris gracilis*, *Heterocarpus oryx*, *Nematocarcinus ensiferus*, and *N. cursor* have normal black eyes a little smaller than the allied shallow-water species; *Ethusina abyssicola* and *Parapagurus pilosimanus* have distinctly faceted black eyes, which, though very much smaller than in most shallow-water species, are still fully as large and apparently quite as perfect as in those of some shallow-water species, in which they are evidently sensitive to ordinary changes of light. The eyes of the species of *Glyphocrangon* are very large, with the faceted surface much larger than in the allied shallow-water species; but they are borne on very short stalks with comparatively little mobility, and have dark purple instead of black pigment; the eyes of *Pontophilus abyssi* are lighter in colour than those of the species of *Glyphocrangon*, but are faceted and apparently have some of the normal visual elements; all the species of *Munidopsis* and *Pentacheles* have peculiarly modified eyes from which the normal visual elements are apparently wanting. Of these twenty-one abyssal species, eight are thus seen to have normal black eyes, two have abnormally small eyes, and three have eyes with purplish or very light-coloured pigment, while eight have eyes of doubtful function. If we confine the examination to the five species taken below 2000 fathoms, we have one with well-developed black eyes, two with abnormally small black eyes, one with light-coloured eyes, and one with eyes of doubtful function.

These facts and the comparison of the eyes and the colour of the abyssal species with the blind and colourless cave-dwelling Crustaceans certainly indicate some difference in the conditions as to light in caverns and in the abysses of the ocean, and make it appear probable, in spite of the objections of the physicists, that some kind of luminous vibrations do penetrate to depths exceeding even 2000 fathoms. The fact that, excluding shallow-water species, there is no definite relation between the amount of the modification of the eyes and the depth which the species inhabit, many of the species with the most highly modified eyes being inhabitants of much less than 1000 fathoms, might at first be thought antagonistic to this view. But when we consider how vastly greater the purity of the water must be in the deep ocean far from land than in the comparatively shallow waters near the borders of the continents, and how much more transparent the waters of the ocean abysses than the surface waters above, we can readily understand that there may usually be as much light at 2000 fathoms in mid-ocean as at 500, or even at 200, near a continental border. These considerations also explain how the eyes of specimens of species like *Parapagurus pilosimanus*, coming from 2220 fathoms, are not perceptibly different from the eyes of specimens from 250 fathoms.

Although some abyssal species do have well-developed black eyes, there can be no question that there is a tendency towards very radical modification or obliteration of the normal visual organs in species inhabiting deep water. The simplest and most direct form of this tendency is shown in the gradual reduction in the number of the visual elements, resulting in the obsolescence and in some cases in final obliteration of the eye. The stages of such a process are well represented even among the adults of living species. The abyssal species with black eyes referred to in a previous paragraph contain the first part of such a series, beginning with species like *Geryon quinquedens* and *Lithodes Agassizii* and ending with *Ethusina abyssicola*, in which there are only a few visual elements at the tips of the immobile eyestalks. A still later stage is represented by A. Milne-Edwards's genus *Cymonomus*, in which the eyestalks are immobile spiny rods tapering to obtuse points, without visual elements or even (according to the description) a cornea. *Cymonomus* is not known to be an abyssal genus, neither of the species having been recorded from much below 700 fathoms, and is a good example of the fact already mentioned that many of the species with the most highly modified eyes are inhabitants of comparatively shallow water. There are, however, several cases of closely allied

species inhabiting different depths where the eyes of the deeper-water species are much the smaller; for example: *Sympagurus pictus*, 164 to 264, and *Parapagurus pilosimanus*, 250 to 2221 fathoms; *Pontophilus gracilis*, 225 to 458, and *P. abyssi*, 1917 to 2221 fathoms; and *Nematocarcinus cursor*, 384 to 838, and *N. ensiferus*, 588 to 2033 fathoms.

In a large number of deep-water and abyssal species the ocular pigment is dark purplish, brownish, reddish, light purplish, light reddish, or even nearly colourless, while the number of visual elements may be either very much less or very much greater than usual. The eyes of the species of *Glyphocrangon* and of *Benthonectes* are good examples of highly developed eyes of this class. In many cases the presence of light-coloured pigment is accompanied with reduction in the number of visual elements precisely as in black eyes, *Parapasiphaë sulcatifrons*, *P. cristata*, *Acanthephyra microphthalma*, and the species of *Hymenodora* being good examples.

In other cases there are apparently radical modifications in the structural elements of the eye without manifest obsolescence. The large and highly-developed but very short-stalked eyes of the species of *Glyphocrangon*, apparently specialized for use in deep water, probably represent one of the earlier stages of a transformation which results finally in the obliteration of the visual elements of the normal compound eye and the substitution of an essentially different sensory structure. In *Pontophilus abyssi* the transformation has gone further; the eyes, though fully as large as in the allied shallow-water species, are nearly colourless, not very distinctly faceted, and have probably begun to lose the normal visual elements over a portion of the surface. In the eyes of several of the species of *Munidopsis* the normal visual elements have entirely disappeared, and there is an expanded transparent cornea backed by whitish pigment and nervous elements of some kind. I am well aware that there is as yet no conclusive evidence that these colourless eyes are anything more than the functionless remnants of post-embryonic or inherited organs; but the fact that in some species they are as large as the normal eyes of allied shallow-water forms is certainly a strong argument against this view. In the species of *Pentacheles* there is still better evidence that the eyes are not functionless; for, although they have retreated beneath the front of the carapace, they are still exposed above by the formation of a deep sinus in the margin, and the ocular lobe itself has thrown off a process which is exposed in a special sinus in the ventral margin. It is easy to conceive how these highly modified eyes of *Pentacheles* may have been derived from eyes like those

of the species of *Glyphocrangon* and *Pontophilus abyssi* through a stage like the eyes of *Calocaris*, which are practically sessile, have lost all of the normal visual elements, and have only colourless pigment, but still present a large flattened transparent cornea at the anterior margin of the carapace.

It is interesting to note that the highly modified eyes of *Pentacheles* are found in a well-defined group, all the species of which have probably been inhabitants of deep water for considerable geological periods; while the equally deep-water species with less modified or obsolescent eyes are much more closely allied to shallow-water species, from whose ancestors they may have been derived in comparatively recent times.

The large size and small number of the eggs is a very marked characteristic of many deep-sea Decapoda. The eggs are extraordinarily large in several species of *Munidopsis*, *Glyphocrangon*, and *Bythocaris*, and in *Elasmonotus inermis*, *Sabinea princeps*, and *Pasiphaë princeps*. But the largest Crustacean egg which I have seen is that of the little shrimp *Parapasiphaë sulcatifrons*, which carries only from fifteen to twenty eggs, each of which is more than 4 millim. in diameter, and approximately equal to a hundredth of the bulk of the animal producing it. My suggestion (Amer. Journ. Sci. xxviii. p. 56, 1884) that the great size of the eggs in the deep-water Decapoda was probably accompanied by an abbreviated metamorphosis within the egg, thus producing young of large size and in an advanced stage of development, specially fitting them to live under conditions similar to those environing the adults, has already been proved true by Prof. G. O. Sars in the case of *Bythocaris leucopis*, in which the young are in a stage essentially like the adult before leaving the egg.

Although the great size of the eggs is highly characteristic of many deep-water species, it is by no means characteristic of all; and, as the following Table of measurements shows, the size of the eggs has no definite relation to the bathymetrical habitat and is often very different in closely allied species, even when both are inhabitants of deep water. For example, the eggs of *Acanthephyra gracilis* are very large, while those of *A. brevirostris* and *A. Agassizii* are normally small, and those of *Pontophilus abyssi* are fully as small as in the comparatively shallow-water species of the genus, and much smaller than those of many shallow-water species of Crangonidæ.

For the purpose of comparing the size of the eggs of deep- and shallow-water species, measurements of the eggs of a number of species of Decapoda, and in some cases the number, or approximate number, carried by an individual, are given in

the following Table, in which the bathymetrical habitat is given approximately in even hundreds of fathoms, habitats of less than one hundred fathoms being indicated by −100; the diameter is the approximate average of the longer and shorter diameters, usually of several eggs from two or three individuals; and the number, or estimated number, of eggs is for a single individual of medium or large size, or the extremes of variation in two or more individuals.

Diameter and Number of Decapod Eggs.

Species and Bathymetrical Habitat.		Diameter.	Number.
BRACHYURA.			
	fathoms.	millim.	
Callinectes hastatus	−100	0·28	4,500,000
Geryon quinquedens	100 to 1100	0·74	47,000
ANOMURA.			
Latreillia elegans........	−100 to 200	0·45	1,660
Eupagurus bernhardus ..	−100	0·57	
—— politus............	−100 to 600	1·12	2,000
Parapagurus pilosimanus..	300 to 2200	1·2	
Munidopsis curvirostra ..	100 to 1300	1·6	14 to 52
—— crassa	1700 to 2600	3·5	
—— rostata............	1100 to 1400	3·7	230
Anoplonotus politus	−100 to 200	1·1	25
MACRURA.			
Pentacheles nanus	700 to 1000	0·77	1250 to 1500
Homarus americanus	−100	1·9	12,000 to 20,000
Crangon vulgaris........	−100	0·47	
Sclerocrangon Agassizii ..	400 to 1000	2·5	
Pontophilus norvegicus ..	100 to 600	1·1	
—— brevirostris........	−100 to 200	0·7	
—— abyssi	1900 to 2200	0·7	
Sabinea princeps........	300 to 900	2·8	353
—— Sarsii	100 to 200	1·3	
Glyphocrangon sculptus..	1000 to 1400	3·0	97
—— longirostris........	800 to 1100	3·0	86
Palæmon forceps	−100	0·6	7000
Palæmonetes vulgaris ..	−100	0·7	360
Nematocarcinus ensiferus	600 to 2000	0·68	16,000 to 21,000
—— cursor	400 to 800	0·64	20,000
Acanthephyra Agassizii..	−100 to 3000	0·85	5,000
—— brevirostris........	1400 to 3000	0·70	
—— gracilis	1600 to 2500	2·5	21
Pasiphaë tarda	100 to 200	2·0	94
—— princeps	400 to 1400	3·5	
Parapasiphae sulcatifrons	500 to 3000	4·2	15 to 19

New Haven, Connecticut, U. S. A.,
December 1885.

XVIII.—*On the Geodephagous Coleoptera collected by Mr. George Lewis in Ceylon.* By H. W. Bates, F.R.S.

[Concluded from p. 156.]

Subfamily LACHNOPHORINÆ.

Selina Westermanni.

Selina Westermanni, Motschulsky, Etud. Ent. 1857, p. 110, t. i. fig. 6; Schaum, Berl. ent. Zeit. 1860, p. 172, t. iii. fig 11 *a*, *b* (=*Pselaphanax setosus*, Walker, Ann. & Mag. Nat. Hist. 1859, iii. p. 52); Waterhouse, Aids to Identif. no. 15, pl. cxx.

Peradeniya; running in moist places in the half-dry river.

Subfamily ODACANTHINÆ.

Ophionea cyanocephala.

Ophionea cyanocephala, Fabr. Ent. Syst. Suppl. p. 60; Dej. Sp. Gén. i. p. 173.

Colombo, in marshes.

Ophionea interstitialis.

Ophionea interstitialis, Schmidt-Gobel, Faun. Col. Birm. p. 20.

Colombo, in marshes.

Casnonia hæmorrhoïdalis.

Casnonia hæmorrhoidalis, Motschulsky, Bull. Mosc. 1864, ii. p. 219; Chaud. Bull. Mosc. 1872, i. p. 404.

Colombo, in marshes.

This species must be very near Nietner's *C. punctata* (Ann. & Mag. Nat. Hist. 1858), but his description does not agree in many points, especially in the colour of the palpi, base of antennæ, and legs.

Subfamily POLYSTICHINÆ.

Planetes simplex.

E. eleganti (Nietner) affinis; differt colore supra toto nigro; epistomate, partibus oris, antennis pedibusque rufo-testaceis; capite thoraceque politis discrete punctatis, vertice medio impunctato; thorace sat augusto, subcordato, angulis posticis subacutis, margine tenui angustissime reflexo; elytris subopacis, lineis totis fere æqualiter elevatis.

Long. 7 millim.

Peradeniya; dry sandy bed of river.

One example only.

Helluodes taprobanæ.

Helluodes taprobanæ, Westwood, Trans. Ent. Soc. iv. p 279, t xxi. fig. B.

Kitugalle, in Rest-house, at night.

Physocrotaphus ceylonicus.

Physocrotaphus ceylonicus, Parry, Trans. Ent. Soc. v. p. 180, t. xviii. fig. 4.

Dikoya.

Pogonoglossus —— ?

Kandy.

One example, apparently belonging to this genus, but differing in the upper surface being clothed with blonde hairs. It is, however, not in good condition and cannot be satisfactorily determined.

Subfamily *Helluoninæ.*

Creagris labrosa.

Creagris labrosa, Nietner, Journ. As. Soc. Beng. 1857, p. 139.
Acanthogenius piceus, Schaum, Berl. ent. Zeitschr. 1863, p. 80.

Colombo, old trees.

Chaudoir restored the genus *Creagris* (Nietn.), which Schaum had incorporated with *Acanthogenius*, on account of the bilobed penultimate tarsal joints of the species on which it was founded; with this he restored also the specific name, changed by Schaum, as it had been previously used by Dejean for an African species of *Acanthogenius*.

Omphra rufipes.

Omphra rufipes, Klug, Jahrb. i. p 72.

Colombo.

Subfamily *Brachininæ.*

Pheropsophus bimaculatus.

Pheropsophus bimaculatus, Linn. Mant. p. 532; Dejean, Sp. Gén. i. p. 299; Chaudoir, Monogr. des Brachyn. 1876, p. 24.

Kitugalle.

Pheropsophus fuscicollis.

Pheropsophus fuscicollis, Dej. Sp. Gén. i. p. 306; Chaudoir, Monogr. des Brachyn. 1876, p. 27.

Kitugalle.

Pheropsophus Catoirei.

Pheropsophus Catoirei, Dej. Sp. Gén. i. p. 301, Chaudoir, Monogr. des Brachyn. 1876, p. 14.

Kandy and Peradeniya.

Subfamily ORTHOGONIINÆ.

Orthogonius parallelus.

Orthogonius parallelus, Chaudoir, Ann. Soc. Ent. Belg xiv p. 109.

Subfamily TETRAGONODERINÆ.

Tetragonoderus notaphioides.

Tetragonoderus notaphioides, Motschulsky, Bull. Mosc. 1861, i. p. 99, Chaudoir, Etude Monogr. des Masoréides, des Tetragonodérides, &c. 1876, p. 64.

Dikoya, at high elevations, in refuse.

A species allied to the widely-distributed *T. arcuatus*. In addition to the subapical pale fascia, it has a subbasal macular belt extending from the second to the seventh interstice, and a lateral spot nearer the middle on the seventh and eighth interstices, the surface having a changing silky gloss. Mr. Lewis obtained a good series of the species; in some specimens the subbasal fascia is very faint towards the suture. The thorax has a few ochreous spots, apparently formed of fine tomentum, as in the allied species.

Tetragonoderus cursor.

T. dilatato (Wiedm.) affinis; differt elytrorum fasciis multo angustioribus anterioreque marginem haud attingente, etc. Fuscescenti-cupreus, sericeus; antennis, palpis et pedibus melleo-flavis; elytris fasciis maculosis angustis duabus, apud interstitia secundo ad octavum, anteriore versus suturam e maculis segregatis formata; capite thoraceque relative parvis, sericeo-æneis; elytris ampliatis, margine basali minus obliquo quam in *T. dilatato*, angulisque humeralibus minus acutis.

Long. 7. millim.

Kandy, in the moist sand of river-beds.

Belongs to the same section as *T. dilatatus*, in which the intermediate tarsi in the male have four rather broad dilated joints. The hind legs are much elongated and the middle femora in the male abruptly dilated beneath and armed with short spines. The elytral fasciæ are about half the width of those of *T. dilatatus*, but the spots or lineoles of which they are composed have the same proportion *inter se* as they have in that species, as far as the eighth interstice, where they end in *T. cursor*.

Tetragonoderus fimbriatus.

T. dilatato affinis, sed differt thorace latiore, transverso, elytrisque aliter coloratis. Late oblongo-ovatus, nigro-æneus; elytris fusco-testaceis, fasciis latis duabus flavo-testaceis nigro-marginatis, marginem attingentibus anterioreque versus marginem valde dilatata, ibique punctis ocellatis nigro-æneis insignita: antennis, palpis pedibusque flavo-testaceis; abdomine versus apicem rufo-testaceo; elytris interstitio tertio bipunctato.
Long. 7 millim.

Kandy, with *T. cursor*.

Similar in its broad form to *T. dilatatus*, and having four similarly dilated joints to the intermediate tarsi of the male; but the thorax is of broader form and more dilated anteriorly. The head also is not narrowly ovate as in *T. dilatatus*, the eyes especially being more prominent. The anterior elytral fascia is similar in width up to the sixth interstice; but on the seventh and eighth, as also on the margin, it greatly expands, being there one third the length of the elytra. The posterior fascia is nearly of the same proportions as in *T. dilatatus*.

Subfamily COPTODERINÆ.

Tantillus brunneus.

Tantillus brunneus, Chaudoir, Ann. Soc. Ent. Belg. xii. p. 126.

Dikoya, dead branches.

Tantillus vittatus.

Oblongus, nigro-piceus, nitidus; elytris fulvo-testaceis, vitta lata communi suturali (apicem haud attingente) nigro-picea, margine laterali medio infuscato; antennis, palpis pedibusque flavo-testaceis.
Long. 5 millim.

Bogawantalawa.

Differs from *T. brunneus* (the only other known species) in the colour of the elytra, which in *T. brunneus* are uniform blackish brown or piceous. The elytra are truncated in a similar way, and have the two large setiferous punctures on the third interstice in the same position, viz. the first towards the base and the second very near the apex.

Miscelus ceylonicus.

Miscelus ceylonicus, Chaudoir, Berl. ent. Zeitschr. 1861, p. 125.
Cymindis rufiventris, Walker, Ann. & Mag. Nat. Hist. 1858, ii. p. 202.

Colombo.

Holcoderus præmorsus.

Holcoderus præmorsus, Chaudoir, Ann. Soc. Ent. Belg. xii. p. 153.

Bogawantalawa and Dikoya, at high altitudes.

Catascopus cingalensis.

C. faciali et *C. angulato* affinis, sed differt capite post oculos sulco transverso impresso; subviolaceo-cyaneus, capite thoraceque subviridi-cyaneis; fronte prope oculos sicut in *C. faciali* confuse rugato, vertice subtiliter punctulato; elytris apice extus brevissime acute dentato, apice suturali obtuso subrotundatim producto, punctato-striatis, interstitiis 1-4 æqualibus, planis, quinto angustioro parum elevato, septimo angustissime carinato; thorace sicut in *C. angulato*, angulis posticis rectis reflexis.
Long. 12–14 millim.

Kandy and Balangoda.

Differs from all the numerous varieties of the widely-distributed *C. facialis* and *C. angulatus* in the more sharply impressed transverse groove behind the eyes. The groove is, however, not so sharply impressed as in *C. æquatus.* The colour of the elytra is not a rich violet, as on the disk and, in Assamese examples, over the whole surface of *C. facialis*, but a dullish steely violet, with a faint æneous tinge perceptible on the borders. In one of the two examples the outer tooth of the elytral truncature is extremely small; this seems to approach the insect described by Chaudoir erroneously as *C. reductus*, Walker, but it differs in the fifth elytral interstice being not carinated.

Coptodera interrupta.

Coptodera interrupta, Schmidt-Gobel, Faun. Col. Birm. p. 53; Chaudoir, Ann. Soc. Ent. Belg. xii. p. 194.

Colombo.

Mochtherus tetraspilotus.

Mochtherus tetraspilotus, MacLeay, Ann. Jav pp. 25, 47 (*Dromius*); Chaudoir, Ann. Soc. Ent. Belg. xii. p. 241.
Thyreopterus tetrasemus, Dejean, Sp. Gén. v. p. 448.
Mochtherus angulatus, Schmidt-Göbel, Faun. Col. Birm. p. 76.
Panagæus (!) *retractus*, Walker, Ann. & Mag. Nat. Hist. 1858, ii. p. 203.
Cyrtopterus quadrinotatus, Motschulsky, Bull. Mosc. 1861, i. p. 106.

Galle and Colombo.

Dolichoctis quadriplagiatus.

Dolichoctis quadriplagiatus, Motschulsky, Bull. Mosc. 1861, p. 106 (*Cyrtopterus*); Chaudoir, Ann. Soc. Ent. Belg. xii. p. 245.
Colpodes marginicollis, Walker, Ann. & Mag. Nat. Hist. 1850, iii. p. 51.

In many places, on fungi.

The specific name *marginicollis* was used for a *Colpodes* in Chaudoir's 'Monograph,' published the same year as Walker's unrecognizable description.

Dolichoctis vitticollis.

D. quadriplagiato multo minor, piceo-fuscus; thorace late ovato, lateribus late explanatis minime reflexis, angulis posticis late rotundatis, pallide testaceo, vittis duabus piceo-fuscis; elytris marginibus maculisque elongatis utrinque duabus (interdum in vittam conjunctis); palpis, antennis et pedibus pallide testaceis.
Long. $3\frac{3}{4}$–5 millim.

Dikoya; refuse in damp jungle.

The thorax is relatively broader and much more regularly ovate than in *D. quadriplagiatus*, the hind angles being entirely rounded off, the sides evenly rounded, with broadly explanated and very slightly upturned margins. The head is smaller and the eyes less prominent; the elytra are relatively short and ovate in outline; the lateral pale border occupies the two marginal interstices.

Dolichoctis gonioderus.

Angustus, fusco-piceus, nitidus; elytris nigro-piceis; antennis, partibus oris, thoracis margine pedibusque pallide testaceis, femoribus medio tibiisque fuscescentibus, elytris margine laterali et utrinque maculis elongatis tribus (prima antero-discoidali secunda et tertia subapicalibus) pallide testaceis; thorace angusto, hexagono, marginibus lateralibus anguste explanatis, valde reflexis, ante medium utrinque valde angulatis, angulis anticis prominulis, posticis obtusis, margine basali prope angulum obliquato.
Long. 4 millim.

Kitugalle, in refuse. One example only.

Allied to *D. angulicollis* (Chaud.), but the spots of the elytra different in number and position, being three on each elytron—one elongate, not reaching the base, and ending nearly in a point about the middle; the two others shorter, side by side near the apex, the outer spot a little anterior to the inner one.

Dolichoctis fasciola.

D. striatæ quoad formam similis, sed thorace paullo angustiore, elytris maculis rufis quatuor subtransversis. Piceo-fuscus; antennis, palpis, labri margine, genubus, tibiis apice tarsisque melleo-flavis; thorace transverso medio angulato, angulis posticis subrotundatis, margine laterali late reflexo, rufo-testaceo; elytris marginibus et maculis utrinque duabus sat magnis transversim ovatis, rufis, apice oblique sinuato-truncatis.
Long. 5 millim.

Balangoda, under bark among fungi.

Differs from the other similarly-coloured red-spotted species (*D. tetracolon* and *D. tetrastigma*) in the obtuse hind angles of the thorax, which are rounded at their apices, and not preceded by a sinuosity. In this respect it agrees with *D. striata*, from which it differs in the thorax being less broad, its width being not more than one third more than the length. The anterior red spot of the elytra extends from the third to the eighth stria, the posterior (which is narrower) from the first to the eighth. The elytra have not the iridescent gloss that distinguishes *D. striata*, and the margins of the thorax are much paler in colour.

Subfamily *Dromiinæ*.

Dromius orthogonioides.

D. brevicipiti (Bates) affinis; differt thorace late quadrato a medio antice leviter rotundato-angustato, angulis anticis rotundatis etc. Oblongus, piceo-fuscus, subnitidus, thorace marginibus pallidioribus; antennis. partibus oris tarsisque testaceo-flavis, femoribus tibiisque pallide fuscis; capite lato antice brevi et obtuso, oculis magnis; palpis sat crassis, articulo apicali oblongo, apice oblique excavato-truncato; thorace sicut in *Orthogonio* late quadrato, antice rotundato, leviter angustato, angulis anticis omnino rotundatis, posticis rectis, margine laterali late explanato-reflexo, dorso subtiliter transversim striato; elytris oblongis, sat profunde striatis, apice transversim leviter sinuatim truncatis, interstitiis subconvexis, striis fundo hic illic subinterruptis, interstitio septimo seriatim punctato.
Long. 5½ millim.

Dikoya, under bark.

The facies of this species, owing to its broad thorax and oblong parallel-sided outline, is very unlike that of the genus *Dromius*, but all its essential characters are those of that genus. The thickened palpi, with their truncated apices obliquely sliced off and hollowed on one side, are a further development

of what is seen in *D. breviceps* and *D. crassipalpis* of Japan. Many species, including *D. piceus*, have the peculiar row of punctures on the seventh interstice, near the sixth stria, which is a reliable sign of affinity.

Dromius steno.

D. longicipiti (Dej.) quoad formam similis. Ænescenti-fuscus sub-rufescens; antennis, partibus oris pedibusque melleo-flavis; capite elongato, oculis parum prominentibus, fronte et occipite (medio verticis lævi excepto) longitudinaliter strigosis; thorace anguste cordato, lateribus perparum sinuatis, anguste explanato-reflexis, angulis posticis obtusis, dorso transversim strigoso; elytris elongatis ab humeris valde angustis usque ad apicem gradatim leviter dilatatis, apice recte obtuse truncatis, striis omnibus integris sat acute insculptis, interstitiis mediocriter convexis, tertio et septimo seriatim setifero-punctatis.

Long. 6 millim.

Nuwara Eliya, near the lake.

Allied to *D. longiceps*. Palpi with acuminated terminal joints. Claws with about four strong denticulations. The eyes are more prominent than in *D. longiceps*, the thorax similar in shape, but with more distinct hind angles, which form with the base nearly a rectangle, obtuse at the apex; the elytra have rather strongly incised striæ, which are scarce perceptibly punctulated.

Blechrus xanthopus.

Minutus, depressus, fusco- vel nigro-æneus, vix nitidus; antennis palpis et femoribus piceo-fuscis, tibiis tarsisque pallide flavis; capite quam in *B. glabrato* majore, planato, alutaceo; thorace fere sicut in *B. glabrato* cordato, basi rotundato-lobato, angulis exstantibus, acutis; elytris alutaceis, haud profunde striatis.

Long. 2¼ millim.

Colombo. One example.

The legs are coloured and the elytra striated as in *B. strigicollis*; the whole upper surface is subopaque, silky-shining, and very finely alutaceous, the thorax less so than the head and elytra.

Apristus subtransparens.

Apristus subtransparens, Motschulsky, Bull. Mosc. 1861, i. p. 104.

Hadley and Dikoya, running on banks in the mid-day sun.

Agrees very well with Motschulsky's description, except that the surface is much more silky than his phrase "vix

sericeo nitidus" would seem to express, and the thorax can scarcely be called "subtransverso." The species belongs to the narrow forms of the genus, and the thorax is cordate with prominent angles, as broad as long only at its apex.

Lionychus albivittis.

L. quadrillo (Dufts.) quoad formam similis, sed multo minor et relative paullo brevior. Supra totus alutaceus fere opacus, obscure viridi-æneus; elytris utrinque vitta lata testaceo-alba a medio basi (ibique angustata) usque longe ultra medium; antennis articulis 1–2 tibiisque rufo-testaceis; epistomate acute tricarinato; elytris margine basali prope scutellum anguste sinuato, versus humeros valde antice arcuato, dorso subtilissime striatis, sericeis.
Long. 2¾ millim.

Peradeniya, in hot sandy places.

The broad white vitta on each elytron extends from the middle of the base to four fifths the elytral length, and leaves the sutural (one or two interstices) and a broader but more irregular marginal vitta of the dull blackish ground-colour.

Subfamily DEMETRIINÆ.

Tetragonica fusca.

Tetragonica fusca, Motschulsky, Etud. Ent. 1859, p 28.

Nuwara Eliya, Dikoya, and Bogawantalawa; by beating dead branches.

Motschulsky's description of his genus *Tetragonica* is full and accurate; I can only add to it that the feebly emarginated tip of the ligula bears two bristles, that the surface of the tarsi is clothed with a number of stiff hairs, and the side of the thorax has two setæ, the first before the middle and the second near the hind angle. It is nearly allied to *Demetrias*, with which it agrees in the paraglossæ not surrounding the apex of the ligula, which is horny and slightly emarginated, and the acuminated palpi, characters which, according to Chaudoir, exclude *Demetrias* and its allies from his subfamily Calleidinæ. The thorax is truncated at the base and shows no tendency to the lobular form characteristic of the Lebiinæ, Cymindinæ, and most of the Dromiinæ.

The genus *Peliocypas*, of which Schmidt-Göbel describes four species from Burma, agrees exactly with *Tetragonica*, except that the labial palpi are truncated. If it could be supposed that so careful an observer had mistaken the form of the labial palpi, some of his descriptions accord well with Ceylonese species of *Tetragonica*.

Tetragonica mellea.

Melleo-flava; capite thoraceque rufo-vel fusco-testaceis, nitidis; elytris vitta utrinque submarginali vago delimitata (interdum obsoleta) ante apicem intus curvata, fusca; fronte quadrifoveolato, capite post oculos oblique recte angustato; thorace quadrato, lateribus rectis postico perparum sinuatis; elytris anguste elongato-oblongis, postice paullo dilatatis, apice valde oblique sinuato-truncatis, angulo exteriore rotundato, suturalique recto, haud profunde striatis, striis 8–9 approximatis, parallelis, interstitiis planis, tertio punctis setiferis magnis duobus, primo versus basin secundo prope apicem: pedibus curtis, tibiis 4 posticis, intus spinulosis, tarsis supra setis paucis, unguibus pectinatis.
Long. 6 millim.

Colombo.

The four posterior tibiæ though slender are slightly thickened, or calf-shaped, in the middle of their inner sides. The basal joint of the hind tarsi is nearly as long as two to four taken together. The two setiferous punctures of the elytra occupy the whole width of the third interstice.

Tetragonica catenata.

T. melleæ quoad formam simillima; colore obscurior; castaneo-fusca, nitida; elytris castaneo-rufis, post medium fuscis apiceque utrinque macula sat grandi flavo-testacea; antennis, partibus oris pedibusque melleo-flavis; fronte 4-foveolata; thorace quadrato, angulis posticis valde obtusis vel oblique truncatis; elytris interstitiis convexis, tertio punctis setiferis sex, quinto tribus, spatiis inter puncta elongato-tuberculatis.
Long. 5 millim.

Bogawantalawa.

The elongated tubercles or parts of the interstices between the setiferous punctures, which latter extend across the interstices, are chiefly near the base of the elytra.

Tetragonica intermedia.

T. melleæ quoad formam et colores simillima, differt solum vitta fusca, postice haud intus curvata apiceque elytrorum late clare flavescenti; thorace quadrato, angulis posticis fere rectis, nullo modo truncatis; elytris subpunctato-striatis, interstitiis paullo elevatis, tertio et quinto punctis setiferis tribus.
Long. 4¾ millim.

Horton Plains.

Exactly intermediate in colours, in the form of the hind angles of the thorax and elytral interstices, between *T. mellea* and *T. catenata*.

Tetragonica euproctoides.

Brevius, præcipue elytris latius oblongis, postice minus dilatatis, rufo-testaceis; antennis, palpis, pedibus et elytris flavo-testaceis, his sutura, vitta submarginali (per apicem usque ad suturam ducta) fasciaque post medium (apud suturam dilatata) sat vage delimitata, fuscis; thorace brevius quadrato, paullo transverso, lateribus postice leviter sinuatis, angulis posticis fere rectis, apice haud acutis et margine basali prope angulos paullulum obliquato, dorso transversim strigoso; elytris oblongis, apice minus oblique sinuato-truncatis, subpunctulato-striatis, interstitiis fere planis, tertio punctis setiferis duobus, primo versus basin secundo versus apicem.

Long. 5 millim.

Colombo.

In colour and markings resembling Central-American species of *Euproctus*, and, judging from the description, also *Peliocypas signifer* of Schmidt-Göbel. The latter is, however, a much smaller insect ($1\frac{3}{4}$ lin.). The hindmost tibiæ have a calf-like dilatation, much less pronounced than in *T. mellea* and fringed with finer setæ.

Subfamily *Calleidinæ.*

Physodera Eschscholtzii.

Physodera Eschscholtzii, Parry, Trans. Ent. Soc 1849, v. p. 179, t. xviii. fig. 2.

Peradeniya.

Subfamily *Pentagonicinæ.*

Pentagonica transparipes.

Pentagonica transparipes, Motsch. Etud. Ent. 1859, p. 29.

Kandy.

Subfamily *Lebiinæ.*

Lebia exsanguis.

Quoad formam *L. hæmorrhoidali* (Fab.) similis, sed tota pallide testacea, glabra; capite thoraceque lævibus, hoc transverso, marginibus lateralibus late explanato-reflexis; elytris valde lævi-striatis, interstitio tertio bipunctato; tarsis articulo penultimo bilobo.

Long. $4\frac{1}{2}$ millim.

Dikoya.

Belongs to Section I. IV. 2. B. *a*. *β*. §§ of Chaudoir's labyrinthine 'Monographie des Lébiides' (1871).

Note on the remaining Ceylonese Species of Geodephaga described by Walker.

In addition to the species included in the synonymy of the foregoing there are several described by Walker which were not met with by Mr. Lewis. The following notes made on an examination of the types will be useful.

Dromius marginifer.

This is a *Dolichoctis* closely allied to *D. quadriplagiatus*, which Walker described as a *Colpodes*. It agrees in size (6 millim.) with the smaller examples of that species, and is almost exactly the same in colours and markings, the chief difference being that the basal spot of the elytra is not oblique but rounded or slightly transverse and placed near the shoulder. In form the insect is narrower than *D. quadriplagiatus*; the thorax is rather more quadrate, *i. e.* less rounded on the sides, but with similarly distinct subrectangular hind angles.

Dromius repandens.

A *Tetragonica* similar in colour to *T. intermedia*, *i. e.* rusty brown, with disk of elytra paler tawny and sides vaguely fuscous. The thorax, however, differs in outline from that of all the described species, being gradually and rather strongly narrowed behind, with rectangular hind angles. The third elytral interstice has two setiferous punctures, one near the base, the other near the apex.

Catascopus reductus.

A very different species from *C. reductus*, Walker, described by Chaudoir. It is one of the smaller species allied to *C. violaceus* (Schmidt-Göbel); the thorax angulated on the sides, the forehead with two strong carinæ on each side, and the elytra metallic olive-green, strongly punctate-striate, with the seventh interstice only slightly elevated.

Scarites designans.

An *Oxylobus* with broad and plane elytral interstices. Chaudoir, in his revised 'Monograph' (1879), refers it to *Scarites sculptilis*, Westw.; it is not clear why, as there is nothing in Westwood's description to lead one so to identify the two species. *O. designans* is distinct from *O. lateralis*, Dej., to which it is referred in the Munich Catalogue.

Morio trogositoides.

As stated above under *M. Walkeri* (p. 143), this is distinguished from that species by the thorax being very distinctly triangularly excised in the middle of the front margin. The anterior angles of the thorax are very prominent, as in *M. orientalis*, from which it seems to differ only in the frontal foveæ not being dilated behind. I have specimens very similar from the Andaman Islands.

Morio cucujoides.

I doubt whether the insect referred doubtfully by Chaudoir to *M. cucujoides* is the same species. The type represents a flat species with red legs, very similar to the widely-distributed *M. luzonicus*, but differing in being a little narrower and having impunctate elytral striæ.

Leistus linearis.

This is the *Celænephes parallelus* of Schmidt-Göbel, a widely-distributed Indian and Australasian species. The reference of a Truncatipenne allied to *Dromius* to the genus *Leistus* must be considered one of Walker's greatest feats of random identification.

Maraga planigera.

A small *Orthogonius* with very broad and short thorax, broadest at the hind angles.

Harpalus stolidus.

This is the tolerably well-known tropical Asian *Stenolophus smaragdulus* of Fabricius and Dejean.

Curtonotus compositus.

I have been unable to examine the type of this species satisfactorily. It is a black closely-punctured Harpalid, with reddish legs and the usual lines of punctures on the alternate elytral interstices characteristic of *Platymetopus* and *Selenophorus*. It may be my *Siopelus ferreus*.

Bembidium finitimum.

Is a *Tachys* of the section *Barytachys*; very glossy castaneous, with only two (very sharply incised) striæ on each side of the suture, and the marginal striæ divaricate in the middle of their course; the frontal striæ are short and dupli-

cated on each side, and the thorax is moderately narrowed behind, and not sinuated before the angles.

Platysma retinens.

This belongs to *Eccoptogenius* (Chaudoir), a genus closely allied to *Rembus* and having no near affinity with *Trigonotoma*, near which Chaudoir placed it. Walker's species is closely allied to, if not identical with, *E. mæstus*, Chaud.

Drimostoma marginale.

A Harpalid, with upper surface finely punctured and frontal furrows as in *Bradycellus* and allies. The type being female, its generic position cannot be ascertained.

There remain four species of Walker of which I have no notes, viz. *Clivina recta*, *Agonum placidulum*, *Stenolophus infixus*, and *Tachys rufula*. The synonymy of *Tricondyla femorata* is given in the Munich Catalogue. Of *Tricondyla tumidula* and *scitiscabra*, Mr. C. O. Waterhouse informs me, the types cannot be found.

XIX.—*Notes on the Genus* Terias, *with Descriptions of new Species in the Collection of the British Museum.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

[Plate V.]

I have recently been rearranging the Museum series of the Lepidopterous genus *Terias*, of which genus we possess most of the named forms; as I suspected, our species fully bear out my expressed opinion that any attempt to associate the allied forms without most careful attention to breeding, and that *through several generations* (in order to avoid all possibility of mistake), will result in the union of the entire series (the sections *Xanthidia* and *Eurema* being perhaps excepted) as one variable species, a consummation devoutly to be deprecated.

Of the various modifications of typical *Terias* we have in the Museum series upwards of 150, some of which must certainly be varieties, whereas others doubtless have a full right to be regarded as genuine, because unvarying and locally fixed, species; but it is quite impossible for any one,

our present profound ignorance of the earlier stages of most of the species and our imperfect knowledge of those of all, to lay down the law as to which of these forms is worthy of a distinctive name and which not. In these matters one can only be guided by private opinion.

Terias drona group.

Although the species of this group pass almost imperceptibly into the *T. smilax* group, it is convenient to speak of it as if it were well defined. Of the named forms we possess the following:—

T. pulchella, Boisd.; *T. zoë*, Hopff.; *T. senna*, Feld.; *T. lerna*, Feld.; *T. zoraide*, Feld.; *T. drona*, Horsf.; *T. lisa*, Boisd.; *T. euterpe*, Ménétr.; *T. sulphurina*, Poey; *T. libythea*, Fabr.; *T. cingala*, Moore; *T. santana*, Feld. (=*rubella*, Wall.); *T. venata*, Moore; *T. pallitana*, Moore; *T. ingana*, Wall.; *T. sana*, Butl.; *T. sinta*, Wall.; *T. candace*, Feld.; *T. brigitta*, Cram.

Respecting one or two of the above I have observations to make:—

Terias senna, Felder.

Although this species is most abundant in the North-western Provinces of India, there can be no doubt that it is a wide-ranging species; indeed we have a female from Camorta, and Felder describes the species as coming from the interior of Malacca. Mr. Distant, with the laudable desire of trying to identify it with some known Malaccan species, figures *T. inanata* as representing it; whereas a careful perusal of Felder's description should convince every candid reader that the two forms are as wide apart as any in the genus. If we set aside the description itself, which states that the external border of the primaries is trisinuate—"*the costa and terminal border black-brown, tolerably broad, gradually decreasing, entire internally as far as the third median branch, then unequally bisinuate, before the internal angle more deeply sinuated*"—the remarks at the end of the description are conclusive:—"From the preceding species (*T. santana*) easily to be distinguished by its longer, blunter front wings, broader outer border of the latter, and broader marginal limitation of the hind wings."

Not one of the above-mentioned characters applies to *T. inanata*, which indeed, as Mr. Distant upon reflection will see, cannot be remotely allied to *T. santana*.

Terias zoraide, Felder (*australis*, Wallace).

This is doubtless the representative of *T. drona* occurring in Australia; it is very like the latter, but has comparatively broader and shorter primaries.

Terias drona, Horsfield.

Usually a little darker than the preceding (unless, indeed, the colouring deepens with age). We have it only from Java, the Indian representative usually identified as *T. drona* being the true *T. senna.*

Terias lisa, Boisd.

In Zeller's collection were examples labelled as this species from Texas. I believe them to represent a distinct species, the males differing from typical *T. lisa* in the broader external border of all the wings, that of the primaries with its inner edge very oblique from costa to third median branch, thence transverse and trisinuate to inner margin; the female chiefly differs in its clear sulphur-yellow colour. I am not aware that this species has been named; but so many butterflies have recently been described in North America that I think it better to leave it to students of that fauna than to run the risk of making a synonym.

Terias brigitta, Cramer.

This is the southern representative of *T. candace*; the flesh-tinted under surface of secondaries and apex of primaries readily distinguish it.

Terias hespera, sp. n.

♂. Allied to *T. sinta* from Moreton Bay and to the *T. smilax** group. Wings above gamboge-yellow; primaries slightly pink at the base and sparsely irrorated with black scales; costal margin narrowly black, slightly increasing in width to beyond the cell, when it abruptly widens into a broad apical border, the inner edge of which is oblique and unbroken to the lower radial vein, whence it is quadrisinuate and tapers to the extremity of the first median branch; a minute blackish dot at extremity of submedian vein: secondaries with marginal black dots at the extremities of the veins; fringe pink: body as usual. Primaries below brighter yellow;

* It is a curious thing that Donovan should have included this Central-American insect in his 'Insects of New Holland;' I can only suppose that the specimen was labelled West Indies, that he misread it East Indies, and believed it to be from the Moluccas.

the costal and apical borders broadly flesh-coloured, with golden reflections; internal area sulphur-yellow: secondaries flesh-coloured, with the usual markings indicated by a few brownish scales. Expanse of wings 35 millim.

N.E. Australia.

This species, though extremely like *T. sinta* on the upper surface, differs wholly in the coloration of the under surface.

Terias smilax group.

This, as I have stated, is completely linked to the *T. drona* group, and it passes on smoothly enough to *T. formosa* and allies; but nevertheless it will be convenient to restrict it to the following, so far as our named specimens are concerned:—

T. nelphe, Feld.; *T. smilax*, Donov.; *T. smilacina*, Feld.; *T. chilensis*, Blanch.; *T. deva*, Doubl.; *T. paulina*, Bates; *T. flavilla*, Bates; *T. leuce*, Boisd.; *T. diodina*, Butl.

Terias dina group.

Consisting of a few species slightly deeper in tint than the preceding, and, as a whole, exhibiting rather more distinction in the pattern of the sexes. The following named ones are in the Museum:—

T. mimulus, Butl.; *T. Westwoodii*, Boisd.; *T. dina*, Hübn.; *T. calceolaria*, Butl.

Terias formosa group.

Differing principally from the preceding in the brighter yellow colour of the upper surface and immaculate under surface, in which characters, however, the species closely approach *T. flavilla* and *T. leuce*. Three species are in the Museum:—

T. formosa, Hübn.; *T. harina*, Horsf.; *T. butyrosa*, Butl.

Terias blanda group.

A little brighter in tint than the preceding and with more or less prominent markings on the under surface.

T. mandarina, De l'Orza; *T. attenuata*, Moore; *T. connexiva*, Butl.; *T. fimbriata*, Wall; *T. narcissus*, Butl.; *T. blanda*, Boisd.; *T. Desjardinsii*, Boisd.; *T. aliena*, Butl.

Terias attenuata, Moore.

We have this species from Loo-choo (Oo-Sima); it corresponds with slightly-marked specimens of *T. connexiva* on the upper surface, but the under surface shows its affinity to *T. fimbriata*, being marked after the manner of *T. æsiope*.

Terias fimbriata, Wall.

Above very similar to the most heavily marked specimens of *T. connexiva*, but below heavily ornamented, as in *T. æsiope*. It is a North-west Indian species.

Terias Moorei, sp. n. (Pl. V. fig. 1.)

♂. Wings above bright chrome-yellow; costa of primaries from the middle narrowly greyish; external border narrow, tapering from costa to internal angle, dentate-sinuate internally, the two strongest denticles being at the extremities of the lower radial vein and third median branch: secondaries with black marginal dots connected by grey scales. Wings below bright chrome-yellow; primaries with the inner border pale sulphur-yellow; a black dot near the base of the cell, followed by two 7-shaped markings, the cell terminating in a comma-shaped discocellular spot in outline; all the veins terminating in black dots: secondaries with two black dots at the middle of the cell, an irregular marking in outline at the end of it, and an irregular arched series of more or less angular squamose markings across the disk; veins terminating in black dots. Expanse of wings 45 millim.

Camorta (*De Roepstorff*).

The type of this species was presented to the Museum by Mr. F. Moore.

Terias floricola group.

At this point the bisinuation of the outer border, characteristic of the bulk of the species in the genus, begins to be faintly indicated; it is, however, lost again before attaining the marked character which it possesses in the *T. hecabe* group. The following species are in the Museum:—

T. floricola, Boisd.; *T. lifuana*, Butl.; *T. anemone*, Feld.; *T. hybrida*, Butl.; *T. sinapina*, Butl.; *T. pumilaris*, Butl.; *T. anjuana*, Butl.; *T. asphodelus*, Butl.; *T. laratensis*, Butl.; *T. irregularis*, Moore; *T. apicalis*, Moore.

Terias Swinhoei, sp. n.

Associated by Col. Swinhoe with his series of specimens of *T. asphodelus*, but labelled both "*T. excavata*" and "*T. asphodelus*" amongst his duplicates; it may at once be distinguished from the latter, to which it is most nearly allied, by the wider marginal border and consequently deeper bisinuation of this border on the primaries and the continuous marginal border

of the secondaries in place of the minute black dots observable in *T. asphodelus*. Expanse of wings 31–38 millim.

Bombay and Poona (*Col. Swinhoe*).

The duplicate specimens in Col. Swinhoe's collection were labelled whilst still unset, and had never been subsequently critically examined by him. So far as I remember, his private collection was, with very few exceptions, correctly named, and the species represented by typical specimens.

Terias simplex, sp. n. (Pl. V. fig. 2.)

Terias fimbriata ♀, Moore, P. Z. S. 1882, p 253.

♀. Allied to *T. apicalis*; sulphur-yellow; primaries with an oblong black patch at apex, its inner edge oblique and tapering to a point along the costa, confluent in front with a narrow black marginal border, the inner edge of which shows scarcely a trace of sinuation; fringe grey, with a yellow basal line: secondaries with a marginal series of black dots, fringe a little paler than in the primaries; abdominal border white: body greenish. Under surface as in *T. apicalis*, the spots at the end of the cells being shorter and more suffused than in *T. fimbriata*. Expanse of wings 41 millim.

Kangra, North-west Himalayas (*Hocking*).

Excepting in its yellow colour and superior size the upper surface of this species bears considerable resemblance to *T. gnathene* from the New World; the female of *T. fimbriata* would be much larger and more like the male in pattern.

Terias senegalensis group.

Linked to the preceding and succeeding groups, but differing from the former in the wider apical portion of the outer border of primaries and from the latter in the usually narrower or entirely aborted posterior portion of this border. We have the following named forms:—

T. Boisduvaliana, Mab.; *T. brenda*, Doubl.; *T. silhetana*, Wall.; *T. bisinuata*, Butl.; *T. chalcomiæta*, Butl.; *T. dentilimbata*, Butl.; *T. rotundalis*, Moore; *T. purreea*, Moore; *T. suava*, Boisd.; *T. vallivolans*, Butl.; *T. Bewsheri*, Butl.; *T. senegalensis*, Boisd.; *T. decipiens*, Butl.

Terias Boisduvaliana, Mabille.

We have this species from Ashanti, West Africa (probably Camaroons), Fernando Po, and the island of Johanna; it varies not a little in size, and entirely resembles *T. brenda* upon the upper surface. The species described by Mabille

under the name of *T. hapale* is represented by two females (probably both of this species), which he has figured as sexes.

Terias Templetonii, sp. n.

♂. Chrome-yellow; primaries with black border, as in *T. purreea* and *T. senegalensis*; secondaries with narrow internally-sinuated black border. Wings below gamboge-yellow, with well-defined black marginal dots: primaries with two black dots, followed by a little Σ-shaped marking within the cell; a transverse black-edged spot closing the cell: secondaries with three black ring-spots near the base, a black-edged angular spot at the end of the cell and a discal bisinuated series of irregular squamose and therefore somewhat indistinct brown dashes across the disk. Expanse of wings 42–51 millim. (type 47 millim.).

Ceylon (*Templeton*).

Terias ceres, sp. n. (Pl. V. fig. 3.)

♂. Probably hitherto confounded with *T. floricola*, but nearer to *T. chalcomiæta*. Wings above gamboge-yellow; the black outer border of primaries much wider at apex and more angular than in *T. floricola*, and interrupted at external angle so as to leave only a black point at the extremity of the submedian vein: secondaries with very minute marginal points. Under surface of secondaries and costal third of primaries of a sericeous creamy-yellow colour, remainder of primaries a little paler than above; costal and external margins ochraceous; a small oblique black dash near the base of the cell, an ⋗-shaped brown marking in the centre, and a white-centred brown P-shaped marking closing the cell; an irregular, transverse, subapical, lilacine brownish patch, beyond which the apical area is suffused with reddish brown; black spots at the extremities of all the veins extending into the fringe, which is also tipped with blackish: secondaries with a small brown crescent near base of subcostal area, three brown-edged white dots in an angular series across the basal fourth, and a brown-edged white λ-shaped marking at the end of the cell; an irregularly bisinuated series of squamose greyish dashes across the disk. Expanse of wings 42 millim.

♀. Bright sulphur-yellow, with the apical patch broader both above and below than in the male, so that this female in almost every respect resembles the males of the Indian *T. silhetana*.

♂, Mauritius (*Macgillivray*); ♂, South Africa (*E. C. Buxton*).

Of this species we have five examples exhibiting no variation beyond the more or less strongly pronounced character of the markings on the under surface; no marking is in any case wanting or even indistinct.

Terias æsiope group.

In this group the anterior and posterior portions of the external border are of nearly equal width on each side of the bisinuation; the apical portion, however, a little wider, and widening rapidly from the sinus to the costa. As I have already stated, these distinctions are purely arbitrary, the last species of one group having perhaps as much right to be placed in that following it as the first species of the latter; at the same time it is more convenient to consider a few allied species at a time than to have the whole genus upon one's hands at once. The following are in the Museum:—

T. æsiope, Ménétr.; *T. unduligera*, Butl.; *T. variata*, Butl.; *T. sulphurata*, Butl.; *T. aprica*, Butl.; *T. Hobsoni*, Butl.; *T. hebridina*, Butl.; *T. inanata*, Butl.

Terias æsiope, Ménétriés.

For some years past this species, which is rare in collections, has been entirely misunderstood. The insect figured by Ménétriés is a female, evidently from China; we have it in the Museum from Hong Kong, and Mr. Moore has it from Hainan. The male is very different, resembling on the upper surface my *T. unduligera*, but like its own female on the under surface: we have it from Formosa, Mr. Moore has it from Hainan, and Mr. Distant has figured it as the male of his *T. hecabe*, var. *a*, and gives a number of localities, including the somewhat wide one of continental India, which makes it evident that he has not discriminated between true *T. æsiope* and the form so called in recently published papers.

Terias sulphurata, Butler.

The species from Aru recorded under this name in my list of 'Challenger' Lepidoptera is probably my *T. aprica*, which it agrees with perfectly on the upper surface and very nearly on the under surface. From *T. sulphurata* it differs in its deeper colouring, the transverse instead of oblique inner edge of the outer border towards apex of primaries, and the much less prominent subapical markings on the under surface of these wings. The form occurring at Lifu may also prove to be distinct from *T. sulphurata*, but I should wish to see more specimens before separating it.

Terias hecabe group.

The external border of primaries broad and deeply bisinuated in both sexes; certain Japanese examples of *T. Mariesii*, however (apparently influenced by crossing with *T. anemone*), have the border as in the *T. æsiope* group. The following are in the Museum:—

T. Mariesii, Butl.; *T. hecabe*, Linn.; *T. nicobariensis*, Feld.; *T. solifera*, Butl.; *T. hecabeoides*, Ménétr.; *T. photophila*, Butl.; *T. simulata*, Moore; *T. phanospila*, Feld.; *T. heliophila*, Butl.; *T. maroensis*, Butl.: *T. excavata*, Moore; *T. citrina*, Moore; *T. latimargo*, Hopff.; *T. sari*, Horsf; *T. diversa*, Wall.; *T. curiosus*, Swinh.

Terias hecabe, Linn.

This species was originally described from a Chinese specimen; it, however, ranges, without any variation worth mentioning, from the north of India to northern Australia. The sexes differ chiefly in tint, the male being of a deep gamboge- or even dark chrome-yellow, the female varying from primrose- to lemon-yellow. In both sexes the outer border of the secondaries is narrow and well defined.

Terias phanospila, Felder.

This is the *T. hecabe* of Horsfield's Catalogue, the larva and pupa of which are figured by him. The larva is said to feed on *Æschynomene sesban* and to be found abundantly from January to April. Typical *T. hecabe*, from Ceylon, is said to feed "on Leguminosæ" and on the "Madras thorn."

That the above is distinct from *T. hecabe* I have no doubt; not only is it a larger insect, the male in pattern approaching that sex of *T. æsiope*, both sexes on the under surface also resembling the latter, but the colouring of the upper surface (as described by Felder) is of a deep (ochreous) yellow, showing in certain lights a lilacine gloss.

Terias excavata, Moore.

This species has frequently been mistaken for *T. æsiope*, from which it is perfectly distinct; we have a series of seventeen from Kangra, Cachar, Bombay, Assirghur, Poona, Mhow, and Suttara, most of which were presented to us by Colonel Swinhoe.

Terias hecabeoides, Ménétriés.

Described and figured from a male taken in the N.W. Provinces of India and sent to Ménétriés by Mr. Field; it is

of a clearer brighter yellow colour than *Terias hecabe*, and the outer border of the secondaries, especially of the female, is much broader than in that species. Its range, so far as I can judge, appears to extend eastward from Kurrachee to Assam, and thence southward as far as Malacca. This species has frequently been confounded with *T. hecabe*, owing to the great similarity of the males, but it appears to be distinct.

Terias sari, Horsf.

The typical *T. sari* was described from a female example obtained in Java. In Horsfield and Moore's Catalogue the species is also recorded from Borneo, and a male from this locality in the Museum corresponds so nearly with the female, especially upon the under surface, that I consider it far more likely to be typical *T. sari* ♂ than the form figured by Mr. Distant; yet until the male is received from Java the question must remain undecided. The female from Java has the quadrate apical patch below uninterrupted, as in the smaller form from Malacca.

Terias phœbus, sp. n. (Pl. V. fig. 4.)

♀. Bright lemon-yellow (colour of male *T. hecabeoides*): border of primaries black-brown and very like that of *T. maroensis* (P. Z. S. 1883, pl. xxxviii.), but decidedly narrower upon the costa and with more irregular inner edge; fringe blackish grey; costa sprinkled with black scales: secondaries with the marginal line less perfect and more sinuated than in *T. maroensis*. Under surface more brightly coloured even than above, with markings disposed as in *T. maroensis*, but all of them broader and of a richer chocolate-brown colour; the primaries with an oblique dash in place of the minute blackish dot towards external angle; marginal black dots larger. Expanse of wings 43 millim.

Queensland.

Terias latilimbata, sp. n. (Pl. V. fig. 5.)

♂ ♀. Coloration of *T. hecabeoides*, but the black external border wider throughout and of twice the width on the median interspaces of the primaries, so as greatly to reduce the depth of the bisinuation; the inner edge of the border of the secondaries more strongly dentate-sinuate. Markings below more strongly defined. Expanse of wings 46 millim.

♂, Sumatra (*Wallace*), coll. Hewitson; ♂ ♀, coll. F. Moore.

Allied to *T. diversa* of Wallace, and *T. latimargo* of Hopffer.

Terias bidens, sp. n. (Pl. V. fig. 7.)

♀. Lemon-yellow: primaries with the base and costa irrorated with blackish scales; external border occupying nearly half the wing, confluent with a costal stripe which commences at basal fourth and gradually widens to just beyond the cell, where it meets the external border; the inner edge of the latter crosses the wing transversely from this point to the third median branch and then is interrupted by two unequal tooth-like sinuations, beyond which it is again continued with a slight inward curvature to the inner margin; the border below the bisinuation is about one fourth narrower than above it: secondaries with the external border about twice as wide as in *T. hecabeoides* ♀, its inner edge deeply dentate-sinuate. Under surface as in the preceding species, excepting that there is an irregular transverse streak of subapical brown spots on the primaries, as in species of the *T. æsiope* group. Expanse of wings 49 millim.

Sumatra. Colls. Hewitson and F. Moore.

Also somewhat allied to *T. diversa.*

Terias semifusca, sp. n. (Pl. V. fig. 8.)

♀. Dull lemon-yellow: primaries with the costal margin narrowly black; base and costa irrorated with blackish atoms; external half chocolate-brown, its inner edge not sharply defined but commencing opposite to the end of the cell, crossing the wing transversely to second median branch, then falling obliquely outwards so as to form a shallow sinus on the first median interspace and thence again obliquely outwards to submedian vein and inwards to inner margin: secondaries with the external third occupied by an internally diffused chocolate-brown border; fringes yellow, that along the external border of primaries reddish. Wings below clear lemon-yellow, with markings as in *T. hecabeoides*, excepting that there is an indication of a brownish biangulated, subapical, transverse streak on the primaries. Expanse of wings 45 millim.

Sumatra (*Wallace*). Coll. Hewitson.

Also belonging to the *T. diversa* group.

The three preceding species were in Mr. Wallace's collection, and, considering that he thought *T. diversa* sufficiently distinct to be separated from *T. hecabe*, it is to me incomprehensible how he could have persuaded himself that these far more distinct forms were varieties of the latter species.

Terias leonis, sp. n. (Pl. V. fig. 6.)

♂. Above bright golden yellow (colouring and general aspect

of the "*T. senegalensis*" of Hübner's 'Zuträge,' fig. 969): primaries with the costa sparsely irrorated with black scales; a broad black external border, widest upon the costa, its inner edge running obliquely outwards from the apical third of the margin to the upper radial vein, thence slightly inwards to the third median branch, where it abruptly turns outwards, forming a deep oblique bisinuation as in *T. sari*, from the first median to the submedian it forms an angular sinus; the form of the border in this species therefore is unique: secondaries with pale abdominal border; the veins black at the extremities and terminating in black spots, which expand upon the margin so as almost to form a continuous line. Under surface like *T. hecabeoides.* Expanse of wings 41 millim.

Sierra Leone (*Foxcroft*).

This species should precede *T. curiosus.*

Terias rahel group.

The passage from the *T. hecabe* group into this is so gradual that it is only by placing in it all species in which there is (in one or both sexes) a more or less defined inner marginal border to the primaries that the group can be indicated; yet such species as *T. zita*, *zama*, *rahel*, &c. are so utterly unlike *T. hecabe*, that nobody could speak of them as belonging to the same group. The following are in the Museum:—

T. biformis, Butl.; *T. eumide*, Feld.; *T. tilaha*, Horsf.; *T. invida*, Butl.; *T. Lorquinii*, Feld.; *T. alitha*, Feld.; *T. rahel*, Fabr.; *T. zama*, Feld.; *T. zita*, Feld.; and (in the Hewitson cabinet) *T. tominia*, Voll.

Terias gradiens, sp. n. (Pl. V. fig. 9.)

♂. Chrome-yellow: primaries with the costal border black, the outer border broadly black-brown, its inner edge commencing just beyond the cell and running with an oblique curve to the third median branch, deeply and unequally bisinuated on the median interspaces, then abruptly running inwards and obliquely downwards, so that the lower part of the border fills nearly half the area between the first median branch and the inner margin, the whole length of the inner margin being also somewhat narrowly black: secondaries with broad black-brown border, narrowing towards apex, its inner edge dentate-sinuate, much as in *T. alitha* from the Philippines. Under surface pale dull lemon-yellow with indistinct markings, the outer border narrowly brown and diffused as in *T. rahel.* Expanse of wings 45 millim.

Borneo (from the E. Indian Museum).

This species should be placed between *T. eumide* and *T. tilaha*, though the secondaries more nearly resemble *T. invida.*

Terias anguligera, sp. n. (Pl. V. fig. 10.)

This is the representative of the preceding species at Tondano, and differs from it in the much broader outer border to the wings, that of the primaries internally forming five abrupt angles instead of the curves of *T. gradiens*, the internal border of the primaries also not reaching the base, but tapering off to a point. Under surface with the markings much more strongly defined. Expanse of wings 55 millim.

Tondano (*Wallace*). Coll. Hewitson.

This was labelled "*T. eumide*" and associated with *T. hecabe* by Hewitson; but it is widely distinct from Felder's species, the description of which refers to a pale sulphur-yellow insect, which we have in the Museum collection from near Macassar. A third species nearer to *T. gradiens*, from the Sulla Islands, has been presented to the Museum by Mr. Moore; it is, however, imperfect.

Terias candida group.

T. celebensis, Wall.; *T. xanthomelæna*, Salv.; *T. candida*, Cram.; *T. puella*, Boisd.; *T. virgo*, Wall.

Though connected with the preceding group through *T. celebensis* and *T. tominia*, there is at present a slight gap between this group and the next.

Terias celebensis, Wall.

The male is perfectly intermediate between that sex of *T. tominia* and *T. xanthomelæna*; the female more closely resembles *T. tominia*. In the Hewitson cabinet are two males apparently of distinct though allied species—one, marked "Mak.," being doubtless the type of Wallace's *T. celebensis* ♂ from Macassar, the other, marked "Sula," being evidently his Sulla-Island specimen. On such slender material it would be rash to separate two closely allied forms from the same district, although there is hardly a living lepidopterist who, in this genus, has not described forms more closely resembling each other.

Terias nise group.

T. regularis, Butl.; *T. neda*, Godt.; *T. æquatorialis*, Feld.; *T. nise*, Cram.; *T. musa*, Fabr.; *T. mana*, Boisd.; *T. agave*, Cram.; *T. albula*, Cram.; *T. sinoë*, Godt.; *T. clara*, Bates; *T. marginella*, Feld.

In this group the transition from yellow to white species is clearly traceable, though a few links are still wanting (in colour only, not in pattern).

Terias messalina group.

T. messalina, Fabr.; *T. gnathene*, Boisd.

Though much resembling the preceding group on the upper surface, I believe that these are merely white species of the *T. dina* group.

Terias herla group.

T. betheseba, Jans.; *T. herla*, M'Leay; *T. vagans*, Wall.; *T. Jægeri*, Ménétr.; *T. læta*, Boisd.; *T. subfervens*, Butl.

This group is perfectly connected through *T. betheseba* with the *T. nise* group (*T. regularis*), and therefore in arranging the genus I have placed it between *T. regularis* and *T. neda*; yet the acute primaries of some of the species, and the unusual style of pattern and coloration on the under surface of their wings, suggests that they should rightly terminate the genus. It is, of course, impossible to arrange every large genus in a linear series, for, at certain points, two divergent series will occasionally branch out, as appears to have occurred in the present instance.

Terias Jægeri, Ménétriés.

This species has of late years been incorrectly identified with a Japanese butterfly, from which it is perfectly distinct: it was described from a N.W. Indian specimen, and is without doubt the pale representative of *T. læta*; but whether it is distinct, or is a seasonal form or mere dimorphic variety of *T. læta*, can only be proved by repeated observation on some spot where it abounds or by careful breeding. The point being doubtful, I hesitate to separate the Japanese form from *T. subfervens* of S. Corea: it differs from it normally as *T. Jægeri* does from *T. læta*; but individuals in a large series obtained in Japan show a tendency towards the fiery under-surface colouring of *T. subfervens*.

The species described under the names *T. reticulata* and *T. atinas* are tailless species of *Sphænogona*, their neuration being quite different from that of *Terias*.

XX.—*On some new or imperfectly-known Species of Stromatoporoids.* By H. Alleyne Nicholson, M.D., D.Sc., Regius Professor of Natural History in the University of Aberdeen.—Part I.

[Plates VI.-VIII.]

Having been for some time engaged in the preparation of a Monograph of the British Stromatoporoids for the Palæonto-

graphical Society, I have had occasion to study a very extensive series of forms belonging to the same group from the Devonian and Silurian formations of the Continent of Europe. Some of these are new, while others are incompletely known, and though I have had the opportunity of figuring some of these in the first part of my Monograph, I have not been able to give any descriptions of them. In the present communication therefore I propose to give brief descriptions, accompanied by figures, of some of the new or imperfectly-known types in question, reserving for a future memoir a number of further forms which similarly require illustration and description. The figures given all represent the microscopic structure of the species described, want of space rendering it impossible to figure the actual specimens from which the microscopic slides were taken. This omission is the less to be regretted as specific and generic distinctions, in the great majority of cases, among the Stromatoporoids are necessarily drawn from the details of the microscopic structure, the general form and mode of growth often being precisely the same in types of the most diverse affinities, while very wide variations in these particulars may be found within the limits of a single species. Several of the species described occur in Britain; but, with one or two exceptions, the figures given are taken from foreign specimens, as I shall have the opportunity of fully illustrating elsewhere the British examples of the same species. I may add that, except in the case of two figures (Pl. VI. figs. 6 *a* and 7 *a*), the drawings are all on a uniform scale of enlargement, being magnified about twelve times; and I have been greatly assisted in their preparation by a series of excellent photographs taken for me by Mr. George Gellie, of Aberdeen.

Actinostroma clathratum, Nich. (Pl. VI. figs. 1–3.)

Stromatopora concentrica, auctt.

Cœnosteum massive and very irregular in shape, usually spheroidal in form, growing from a small base of attachment, and consisting of numerous successive strata superimposed one upon the other. Radial pillars stout, usually from $\frac{1}{4}$ to $\frac{1}{3}$ millim. apart, the concentric laminæ being in general placed at a similar distance apart. The horizontal processes or "arms" are given off from the radial pillars with great regularity in radiating whorls, the result being the formation of an angular meshwork, which in tangential sections has a close resemblance to the structure of an hexactinellid sponge. The angular pores, formed as above, served for the emission of the

zoöids, and definite tabulate zoöidal tubes are not present. Astrorhizæ are feebly represented or may be wholly wanting. The surface is not furnished with regular eminences or "mamelons."

Obs. This species is the one which has most generally been identified with *Stromatopora concentrica*, Goldf., though various other species have been from time to time referred to under the name of *S. concentrica*. The present species has been more particularly identified with *S. concentrica*, Goldf., by Bargatzky * ('Stromatoporen des rheinischen Devons,' p. 54). I have elsewhere pointed out, however (Mon. Brit. Strom. p. 3), that an examination of the original specimen of *Stromatopora concentrica*, Goldf., now in the museum of the University of Bonn, proves conclusively that this often-quoted type belongs to a totally different section of Stromatoporoids from that in which the present species is to be placed. I have therefore been compelled to establish the new genus *Actinostroma* for the reception of this and of a number of related types, and to give a new specific title to the form now under consideration.

Actinostroma clathratum, Nich., grows usually in irregular rounded masses, generally, if not always, with a non-epithecate base. Mostly well-marked strata of growth, or "latilaminæ," are observable, and the radial pillars are "continuous" (as in the genus *Actinostroma* as a whole), and pass from the bottom to the top of each stratum, however thick. The pillars are stout and rounded, often showing in cross sections (Pl. VI. figs. 1 and 3) traces of an axial canal. In vertical sections well-marked concentric laminæ are seen (Pl. VI. fig. 2). The pillars and laminæ are about the same average distance apart, viz. from $\frac{1}{6}$ to $\frac{1}{4}$ millim., German specimens having these structures closer than English examples †. The horizontal "arms" are very regularly produced, and give rise by their union to an extremely regular "hexactinellid" structure, the zoöidal pores being angular in shape (Pl. VI. figs. 1 and 2).

* Having had the advantage of examining many of Bargatzky's specimens with himself, and having purchased his collection since his death, I am able to speak confidently as to most of the types described in his work on the Stromatoporoids of the Rhenish Devonian formation.

† Owing to the great range of individual variation little stress can be laid in most Stromatoporoids upon precise measurements, such as the above. It is also noticeable that if we compare specimens of what we must regard as the same species from distant localities (*i. e.* specimens from the British Devonian rocks with others from the Rhenish Devonian, or specimens from the British Silurian with examples from the same formation in Sweden or Esthonia), we find them to invariably exhibit certain slight but constant differences.

"Astrorhizæ" seem to be generally wanting in German examples, but are usually present, though very feebly developed, in British specimens.

The species with which *A. clathratum* is most nearly allied is *A. verrucosum*, Goldf., the differences between the two being wholly as to their mode of growth. From its next nearest ally, viz. *A. hebbornense*, Nich. (=*Stromatopora astroites*, Barg.), the present species is distinguished by its much stouter pillars and generally coarser structure, and also by the fact that the latter possesses very well developed astrorhizæ, which are arranged in vertical groups.

Formation and Locality. Common in the Middle Devonian of Hebborn (Schladethal) and in other localities in the Paffrath district; also very abundant in the same formation in the Eifel (Gerolstein, Sotenich, &c.). Abundant in the Middle Devonian of Devonshire (Dartington &c.).

Actinostroma verrucosum, Goldf., sp.

Ceriopora verrucosa, Goldf. Petref. Germ. Taf. x. fig. 6 (1826).
Stromatopora verrucosa, Bargatzky, Die Stromatoporen des rheinischen Devons, p. 55 (1881).

Obs. The minute structure of this species is in all essential respects identical with that of *A. clathratum*, Nich.; but the cœnosteum is always developed round a series of separate centres of growth, round which the laminæ are concentrically produced. Hence the concentric laminæ are regularly undulated and the surface exhibits numerous prominent conical eminences or "mamelons," usually of considerable size, each of these representing a centre or axis of growth.

Formation and Locality. Comparatively rare in the Middle Devonian formation of Büchel (Paffrath district), and also in the same formation in the Eifel (Sötenich, Gerolstein, &c.). I have not recognized the species as yet in the Devonian formation of Britain.

Actinostroma hebbornense, Nich.
(Pl. VII. figs. 7 and 8.)

Stromatopora astroites, Bargatzky, Die Stromatoporen des rheinischen Devons, p. 56 (1881).
[Non *Stromatopora astroites*, Rosen.]

The cœnosteum in this species is massive and very regularly laminated, the surfaces of the laminæ being smooth and exhibiting numerous large astrorhizæ, the centres of which are usually from 6 to 8 millim. apart. The radial pillars are "continuous," slender, and placed at about ⅙ millim. apart, the same

average distance separating the concentric laminæ. The horizontal "arms" given out by the radial pillars are regularly produced in whorls and give rise to an angular meshwork.

Obs. This species was identified by Bargatzky with the *Stromatopora astroites* of von Rosen. I have, however, carefully examined the original specimens of von Rosen's species and find it to be quite distinct, as I shall immediately show. It has therefore been necessary to give a new specific name to the present species. *A. hebbornense* is nearly related to *A. clathratum*, but differs in the obvious character of the possession of numerous large astrorhizæ, which, according to my observations, are usually arranged in vertical groups and are connected with a main vertical canal belonging to each group. From the presence of the astrorhizæ the species resembles the form which I shall describe as *A. stellulatum*, with which I was at first disposed to identify it (Mon. Brit. Strom. p. 76). Further examination, however, has shown that it is only in this single character that these two forms are closely related. The nearest ally of *A. hebbornense* is undoubtedly *A. clathratum*, the two agreeing closely in general structure, and especially in the fact that the "arms" in both give rise to a regularly angular network (Pl. VII. fig. 7). The species is, however, distinguished from *A. clathratum* not only by its abundant and large astrorhizæ, but also by the much more slender and delicate character of the radial pillars (Pl. VII. fig. 8).

Formation and Locality. Abundant in the Middle Devonian of Hebborn (Schladethal), in the Paffrath district. I have not yet identified this species from either the Eifel or from Devonshire.

Actinostroma? astroites, Rosen.
(Pl. VI. figs. 6–7 *a*.)

Stromatopora astroites, Rosen, Ueber die Natur der Stromatoporen, p. 62, pl. ii. figs. 6 and 7 (1867).
[Non *Stromatopora astroites*, Bargatzky.]

The cœnosteum of this species is massive and grows in successive strata, or "latilaminæ," of varying thickness. The surfaces of all the strata are covered with well-marked branching astrorhizæ, the centres of which are placed about 10 or 12 millim. apart. In minute structure the skeleton is apparently formed of exceedingly delicate and close-set radial pillars, which are placed from $\frac{1}{12}$ to $\frac{1}{15}$ millim. apart or even closer, and are united by few horizontal "arms." Tangential sections hence show a very delicate "hexactinellid"

structure. In vertical sections (Pl. VI. fig. 7) the entire skeleton is seen to be divided by well-marked concentric lines which are placed at variable intervals, usually in groups of close-set lines separated by wider bands in which these lines are few or wanting.

Obs. This species has given me much trouble, and I am not yet sure of its affinities. I have examined the original specimens collected by von Rosen, which are now preserved in the museum of the University of Dorpat, and also his microscopic sections of these. The original specimens are, however, highly mineralized, and the thin sections show no clearly recognizable structural characters beyond the concentric lines of growth which are seen in vertical sections. Hence von Rosen only figured the surface of his specimens, showing the well-marked astrorhizæ; but he gave no illustrations of the minute structure. I have also collected a number of specimens from von Rosen's original locality (Kaugatoma-pank) as well as from other localities in the island of Oesel, which agree in every respect with the original specimen upon which the species was founded. Most of these, however, resemble von Rosen's originals in being so highly crystallized that the essential points in their internal structure are not decipherable. Out of a considerable number of specimens which clearly belong to this species I have only found two which show the internal structure in a manner suitable for satisfactory study; and I have figured tangential and vertical sections of these (Pl. VI. figs. 6–7 *a*). Judging from these the species would seem to be an *Actinostroma*, with extraordinarily delicate and close-set radial pillars, which are united by irregular horizontal "arms." The general structure is therefore like that of *Actinostroma intertextum*, Nich., only very much finer. In vertical sections, even in the worst preserved specimens, we can recognize numerous concentric lines of growth (not proper "concentric laminæ"), which are usually placed in groups (Pl. VI. fig. 7 *a*). The astrorhizæ can with difficulty be recognized at all in thin sections, though sufficiently well marked on fractured surfaces.

One of the great difficulties about *A. astroites*, Rosen, is that its vertical sections, especially when in poor preservation, present a curious resemblance to similar sections of certain specimens of *Stromatopora typica*, Rosen. Some specimens of this latter species show, namely, a curious structure of the skeleton-fibre, probably a sort of decomposition, in consequence of which the thick and reticulated skeleton-fibre becomes broken up by innumerable, minute, dark-coloured, vertical and horizontal lines. This remarkable alteration of the skeleton-

fibre from its normal porous condition is well figured by von Rosen (*loc. cit.* pl. i. fig. 2) in a vertical section of *S. typica.* So close is the resemblance thus caused between vertical sections of *A. astroites* and corresponding sections of *S. typica* that I was at first led to think that *A. astroites* would prove to be only a highly altered condition of *S. typica* (Mon. Brit. Strom. p. 12). Since examining better-preserved specimens of *A. astroites* I am, however, satisfied that this view is untenable, since tangential sections of the two species are quite dissimilar. In any case it need hardly be pointed out that the true *A. astroites*, Rosen, is quite distinct from the form to which Bargatzky gave this name and which I have here described as *A. hebbornense.*

Formation and Locality. Silurian (Upper Oesel group), Kaugatoma-pank and Hoheneichen, Island of Oesel. The species also seems to be present in the Wenlock Limestone of Gotland and also of Britain (Ironbridge).

Actinostroma bifarium, Nich. (Pl. VI. figs. 4 and 5.)

The cœnosteum in this species is massive, generally hemispherical in shape, and of considerable size. The radial pillars are "continuous" and of two sizes, large and small. The large radial pillars are from $\frac{1}{2}$ to $\frac{1}{3}$ millim. apart, the small ones are from $\frac{1}{6}$ to $\frac{1}{8}$ millim. apart. All the pillars give out numerous radiating horizontal "arms," which give rise in tangential sections to the characteristic "hexactinellid" structure of all the species of *Actinostroma.* Vertical sections (Pl. VI. fig. 5) show the two kinds of pillars and the "concentric laminæ," the latter being from $\frac{1}{4}$ to $\frac{1}{6}$ millim. apart. Astrorhizæ are wanting.

Obs. This species is of the general type of *A. clathratum*; but it differs from this, as from all other recorded species of the genus, in the possession of two distinct sets of radial pillars of different sizes. The specimens figured are from the Rhenish Devonian rocks; but the species is apparently more abundant in Devonshire than in Germany.

Formation and Locality. Middle Devonian, Teignmouth, Devonshire (in the pebbles of the Triassic conglomerates); also in the Middle Devonian of Büchel (Paffrath district).

Actinostroma stellulatum, Nich. (Pl. VI. figs. 8 and 9.)

Cœnosteum sometimes laminar, with a basal epitheca, sometimes massive, the mass in the latter case being sometimes composed simply of concentrically superposed strata, or being

at other times made up of a series of large-sized cylinders, each of which is composed of concentrically disposed layers. The surfaces of successive strata are sometimes smooth, but are at other times covered with low, rounded, closely approximated eminences or "mamelons." Astrorhizæ are invariably present and are arranged in superposed groups, each group having a common vertical axial canal. The branches of the astrorhizæ are sometimes short, sometimes long, but always delicate. The radial pillars are "continuous" and are about $\frac{1}{8}$ to $\frac{1}{10}$ millim. apart, as are also the well-marked concentric laminæ. The horizontal "arms" given out by the radial pillars appear to be numerous and delicate; but they are usually not visible at all in tangential sections, or only to a limited extent. Hence such sections do not show the typical "hexactinellid" meshwork of the genus *Actinostroma*, but usually closely resemble corresponding sections of the genus *Clathrodictyon*.

Obs. This well-marked species exhibits many interesting and striking variations; but I shall discuss these fully elsewhere. It is most nearly related to *A. hebbornense*, Nich. (=*Stromatopora astroites*, Barg.). It is, however, distinguished from this, as from all the other species of *Actinostroma*, by the fact that tangential sections (Pl. VI. fig. 8) do not show usually the characteristic "hexactinellid" network of the genus. On the contrary, such sections resemble corresponding sections of *Clathrodictyon* in showing the detached ends of the transversely-divided radial pillars either quite separate or partially confluent into vermiculate rows. I have, however, examined specimens in which the typical "hexactinellid" structure can be detected in tangential slices, the "arms" given out by the radial pillars being in these cases very numerous, and capillary in point of size. I shall elsewhere figure the structure in question. The skeletal framework is decidedly closer and more dense than in *A. hebbornense* or *A. clathratum*, and a marked phenomenon in vertical sections (Pl. VI. fig. 9) is the presence of large rounded apertures formed by the cut ends of the radiating astrorhizal tubes. Vertical sections also often show the vertical wall-less canals, from which spring the astrorhizæ of successive interlaminar spaces, and round which the concentric laminæ are usually bent upwards.

Formation and Locality. Abundant in the Middle Devonian of the Eifel (Gerolstein and Gees). I have not hitherto recognized the species in the Paffrath district. Also abundant in the Middle Devonian of Devonshire (Dartington, Lummaton, and Teignmouth).

Actinostroma Schmidtii, Rosen. (Pl. VII. figs. 1 and 2.)

Stromatopora Schmidtii, Rosen, Ueber die Natur der Stromatoporen, p. 64, Taf. v. figs. 1, 2 (1867).

Cœnosteum massive (?). Large astrorhizæ are present, and are arranged in vertical groups, each group springing from a vertical axial canal. The branches of the astrorhizæ are of large size and very slightly subdivided, and the vertical axial canals are also of remarkably large size. The skeletal tissue consists of delicate, often compressed, radial pillars, of the "continuous" type, placed about $\frac{1}{8}$ millim. apart, sometimes arranged in rows. The pillars give off a small number of delicate horizontal "arms," which give rise to a network of oblong or irregular meshes. Vertical sections show that certain of the pillars are larger than others (Pl. VII. fig. 2); but this feature does not appear to be recognizable in tangential sections.

Obs. This beautiful species is conclusively shown by an examination of the original specimen and slides in the University of Dorpat to be a true *Actinostroma*. It is most nearly allied to the species which I have named *A. intertextum*. It is, however, distinguished from this by its large and quite peculiar astrorhizæ, by the small size and often linear shape of the radial pillars, by the fact that the network formed by the horizontal "arms" consists of oblong rather than of triangular meshes, and by the presence in vertical sections of a limited number of pillars of larger than average size. The "concentric laminæ" are also very imperfectly developed, and are only represented by loose reticulated fibres.

Locality and Formation. Silurian (Upper Oesel group). Kaugatoma-pank, Esthonia. The species has not yet been recognized either in Gotland or in Britain.

Actinostroma intertextum, Nich. (Pl. VII. figs. 3–6.)

The cœnosteum has the form of a laminar, more or less circular expansion, which may reach half a foot in diameter and an inch or more in thickness, and which is covered basally by a striated epitheca. The surface shows astrorhizæ, but these are of moderate size and do not appear to be arranged in vertical groups. The radial pillars are "continuous," slender, and placed about $\frac{1}{8}$ millim. apart; they produce numerous slender horizontal "arms," the union of which gives rise to a close "hexactinellid" network, the meshes of which are mostly more or less triangular. The "concentric laminæ"

are incompletely developed and are rather of the nature of a loose reticulation.

Obs. I shall describe this species more fully hereafter. It is distinguished from most of the members of the genus by the delicacy of the skeletal tissue, the radial pillars being exceedingly delicate, and also by the loosely reticulate character of the concentric laminæ (Pl. VII. fig. 4). It is also characterized by the general regularity of the hexactinellid meshwork displayed in tangential sections (Pl. VII. fig. 3). *A. intertextum* is undoubtedly closely allied to *A. Schmidtii*, Rosen; but, for the reasons previously stated, I think it must in the meanwhile be regarded as a distinct species.

The above brief diagnosis of the species is founded upon British specimens. I have, however, collected examples from the Silurian deposits of Esthonia, which seem to be only a variety of this species, and I have figured tangential and vertical sections of one of these (Pl. VII. figs. 5 & 6). The tangential sections of the Russian examples differ from corresponding sections of British specimens in the much less complete character of the "hexactinellid" meshwork, which is sometimes hardly recognizable at all, only the cut ends of the pillars being visible. This incomplete character, or apparent absence, of the horizontal "arms" can, however, hardly be due to anything save imperfect preservation. Vertical sections (Pl. VII. fig. 6) show the same general structure as corresponding sections of British specimens; but the radial pillars are decidedly more closely set and the concentric laminæ are more completely developed than in the latter. If it should appear to be desirable to indicate these apparently constant differences by a special name, the Russian examples may be called *A. intertextum*, var. *suevicum*.

Formation and Locality. Not very uncommon in the Wenlock Limestone of England (Ironbridge, Much Wenlock, Dudley). The Russian examples are from the Silurian Limestones (zone of *Pentamerus esthonus*) of Kattentack, Esthonia.

*Stromatoporella** *laminata*, Barg., sp.
(Pl. VII. figs. 9 and 10.)

Diapora laminata, Bargatzky, Die Stromatoporen des rheinischen Devons, p. 60 (1881).

The cœnosteum forms a laminar expansion, often of considerable size, which is usually attached by a single point,

* The genus *Stromatoporella*, Nich. (Mon. Brit. Strom. p. 92) includes Stromatoporoids which resemble the species of *Stromatopora*, Goldf. (properly so called), in having a porous or tubulated skeleton-fibre, but in

and is furnished with a striated epitheca, but which is sometimes encrusting. The surface is covered with minute rounded tubercles, many of which, in well-preserved examples, are seen to terminate in minute circular apertures (zoöidal pores). The surface is without marked eminences or "mamelons;" and though astrorhizæ are often present they are very irregularly distributed, and are apparently sometimes wanting. The astrorhizal canals may be furnished with "astrorhizal tabulæ," which have sometimes a vesicular character (Pl. VII. fig. 9). The skeleton-fibre is thick and minutely porous or tubulated; the radial pillars are distinct, and often to some extent "continuous." Hence, in tangential sections, the cut ends of the pillars are largely visible as distinct structures. The "concentric laminæ" are well developed and are placed from $\frac{1}{4}$ to $\frac{1}{5}$ millim. apart, as also are the radial pillars. Zoöidal tubes are irregularly developed, being usually numerous and generally intersected by a variable number of tabulæ.

Obs. I have elsewhere given the reasons which have induced me to reject the generic name of *Diapora*, proposed by Bargatzky, for this species. The "Caunopora-tubes," which constituted an essential feature in Bargatzky's genus *Diapora*, are very commonly present in this species, but are likewise often wanting; while in other closely allied species they seem to be always absent. [In one of the specimens here figured these "Caunopora-tubes" are developed, but in the other they do not exist at all.] Apart from minute details, *S. laminata* is distinguished from its nearest allies (*S. eifeliensis*, Nich., and *S. granulata*, Nich.) by the much more extensive development of the zoöidal tubes, and the more complete structure of the radial pillars than is the case in these latter.

Formation and Locality. Abundant in the Middle Devonian of Büchel (Paffrath district).

Stromatoporella eifeliensis, Nich.
(Pl. VIII. figs. 5, 6, 7.)

The cœnosteum in this species is laminar and expanded, sometimes with a basal epitheca, but more commonly attached by the whole of the lower surface to some foreign body, and varying in thickness from a couple of millim. up to 5 or 6

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which the fusion of the radial and concentric elements of the skeleton into a reticulate framework is much less complete. The radial pillars and concentric laminæ remain quite recognizable, and tangential sections show more or less largely the cut ends of the radial pillars, instead of exhibiting a vermiculate reticulation. The zoöidal tubes are much less highly developed in most species of *Stromatoporella* than they are in *Stromatopora*, and they usually only extend from one interlaminar space to the next above.

centim. The surface may be smooth or may be covered with conical "mamelons," upon which the axial canals of the astrorhizæ open. Astrorhizæ are always present and are remarkably large, their centres being often 2 to 3 centim. or more apart. The astrorhizal canals are furnished with "astrorhizal tabulæ," and the astrorhizal systems are in vertical groups, each group having a common axial canal. The skeleton-fibre is thick and traversed by minute microscopic tubuli (Pl. VIII. figs. 5, 6). The radial pillars are incomplete, being as a rule confined to a single interlaminar space, and average about $\frac{1}{3}$ millim. apart. The "concentric laminæ" are very distinctly developed, and are placed about as far apart as the radial pillars. Definite zoöidal tubes are very imperfectly developed, and often do not exist at all as separate structures.

Obs. This remarkable species exhibits many interesting features which cannot be here discussed. It is closely related to *Stromatoporella granulata* *, Nich., and *S. damnoniensis*, Nich., the three forming a natural group of forms, which are not much more than varietally distinct, though it is convenient to give them separate titles. It is also nearly allied to *S. laminata*, Barg. sp., and to *S. arachnoidea*, Nich. The feature which, more than any other, distinguishes *S. eifeliensis* from all these related types is the extraordinary development of the astrorhizal system. It is further distinguished from *S. damnoniensis* by the greater delicacy of its skeletal tissue; this latter species (as also *S. granulata*) being either destitute of astrorhizæ or having these structures very feebly developed. From *S. laminata*, Barg. sp., it is further distinguished by the fact that the radial pillars are confined to their respective interlaminar spaces, and there are few or no definite zoöidal tubes to be recognized in vertical sections; whereas in the latter species the radial pillars are often continuous through several interlaminar spaces, and there are numerous tabulate zoöidal tubes. From *S. arachnoidea* it is distinguished by the absence or slight development of the extraordinary "interlaminar tabulæ" which characterize the latter.

Formation and Locality. Abundant in the Middle Devonian of the neighbourhood of Gerolstein, in the Eifel. It commonly occurs in the "Caunopora state," as well as entirely without "Caunopora-tubes;" and it is often associated para-

* *Stromatoporella granulata* was described by me (Ann. & Mag. Nat. Hist. 1873, xii. p. 94, pl. iv. figs. 3 and 3 *a*) under the name of *Stromatopora granulata*. I shall give a brief diagnosis of the species later on. It occurs in the Devonian rocks of Canada.

sitically with the curious coral which has been described by Prof. Ferd. Roemer under the name of *Chætetes stromatoporoides.*

Stromatoporella damnoniensis, Nich.
(Pl. VIII. figs. 3 and 4.)

Cœnosteum massive, or in thick laminæ (?). Surface unknown. Astrorhizæ undoubtedly present, and furnished with vertical canals from which they spring, but apparently much less developed than in *S. eifeliensis*. Skeletal tissue exceedingly thick and minutely tubulated. Concentric laminæ very thick and with correspondingly narrow interlaminar spaces. About three concentric laminæ and two interlaminar spaces may occupy the vertical space of 1 millim., the laminæ and intervening spaces being of approximately equal thickness. Radial pillars confined to their respective interlaminar spaces. Irregular, tabulate zoöidal tubes, usually extending only from one interlaminar space to the next above, are present.

Obs. This species is closely allied to *S. eifeliensis*, but seems to be sufficiently distinct to deserve a special name. Its special characteristics, as compared with the latter, are its extraordinarily thick skeleton-fibre, its possession of irregular tabulate zoöidal tubes, and the smaller development of the astrorhizæ.

Formation and Locality. Middle Devonian, Devonshire (Teignmouth). Also in the Middle Devonian of the Eifel (Sötenich).

Stromatoporella arachnoidea, Nich.
(Pl. VIII. figs. 1 and 2.)

Cœnosteum thin and laminar, the specimens examined apparently having a basal epitheca, and being about 1 centim. in thickness. Well-developed astrorhizæ are present, with "astrorhizal tabulæ," and having axial vertical canals, which open on the surface by prominent conical eminences. General structure of the skeleton as in *Stromatoporella eifeliensis*, the skeleton-fibre not being excessively thickened, the radial pillars being confined to their respective interlaminar spaces, and definite zoöidal tubes being very imperfectly developed or wholly absent. The "concentric laminæ" are very well marked, and are placed about ¼ millim. apart. The interlaminar spaces are crossed in every direction by numerous delicate curved vesicular "tabulæ" or calcareous partitions.

Obs. This species presents externally nothing special to separate it from *S. eifeliensis*, except that the specimens I have seen have much more irregular astrorhizæ than the

latter. The general structure of the skeleton is also very similar to that of *S. eifeliensis*, and the skeleton-fibre is traversed by the same delicate, branching, microscopic tubuli. *S. arachnoidea* has, however, the unique feature that the entire space intercepted between the successive laminæ (as also the astrorhizal canals) is crossed by a system of curved tabulæ, which gives to the interlaminar spaces a characteristic vesicular appearance. In many sections of *S. eifeliensis* we can detect curved calcareous partitions which are apparently of the same nature as those just alluded to; but they are always few in number and are often not recognizable at all. For the present, therefore, I think we must regard the present species as distinct.

Formation and Locality. Rare, in the Middle Devonian of Büchel (Paffrath district); and at Gees, in the Eifel.

EXPLANATION OF THE PLATES.

PLATE VI.

Fig. 1 Tangential section of *Actinostroma clathratum*, Nich. (=*Stromatopora concentrica*, Barg.), enlarged about twelve times. Middle Devonian, Hebborn.

Fig. 2. Vertical section of the same, similarly enlarged.

Fig. 3. Tangential section of *Actinostroma clathratum*, Middle Devonian, Dartington, similarly enlarged.

Fig. 4. Tangential section of *Actinostroma infarium*, Nich., enlarged about twelve times. Middle Devonian, Buchel.

Fig. 5. Vertical section of the same, similarly enlarged.

Fig. 6. Tangential section of *Actinostroma? astroites*, Rosen, enlarged about twelve times. Silurian, Oesel.

Fig. 7. Vertical section of the same, similarly enlarged.

Figs. 6 *a*, 7 *a*. Portions of the same sections, enlarged about twenty-four times.

Fig. 8. Tangential section of *Actinostroma stellulatum*, Nich., enlarged about twelve times. Middle Devonian, Gerolstein.

Fig. 9. Vertical section of the same, similarly enlarged.

PLATE VII.

Fig. 1. Tangential section of *Actinostroma Schmidtii*, Rosen, enlarged about twelve times. The section traverses part of an astrorhiza. Silurian, Oesel.

Fig. 2. Vertical section of the same, similarly enlarged. The section cuts one of the vertical canals (*a*) of the astrorhizal system.

Fig. 3. Tangential section of *Actinostroma intertextum*, Nich., enlarged about twelve times. Wenlock Limestone, Ironbridge.

Fig. 4. Vertical section of the same, similarly enlarged.

Fig. 5. Tangential section of *A. intertextum*, var. *suevicum*, enlarged about twelve times. Silurian, Esthonia.

Fig. 6. Vertical section of the same, similarly enlarged.

Fig. 7. Tangential section of *Actinostroma hebbornense*, Nich., enlarged about twelve times. Middle Devonian, Hebborn.
Fig. 8. Vertical section of the same, similarly enlarged.
Fig. 9. Tangential section of *Stromatoporella laminata*, Barg., enlarged about twelve times. The specimen is without "Caunopora-tubes," and the astrorhizal canals (*a*) show curved tabulæ.
Fig. 10. Vertical section of another specimen of the same, in which "Caunopora-tubes" are present, similarly enlarged. Middle Devonian, Buchel.

PLATE VIII.

Fig. 1. Tangential section of *Stromatoporella arachnoidea*, Nich., enlarged about twelve times. Middle Devonian, Buchel.
Fig. 2. Vertical section of the same, similarly enlarged.
Fig. 3. Tangential section of *Stromatoporella damnoniensis*, Nich., enlarged about twelve times. Middle Devonian, Teignmouth.
Fig. 4. Vertical section of the same, similarly enlarged.
Fig. 5. Tangential section of *Stromatoporella eifeliensis*, Nich., enlarged about twelve times. Middle Devonian, Gerolstein.
Fig. 6. Another tangential section of the same, similarly enlarged. The figure exhibits the larger branches of the minute tubuli which traverse the skeleton-fibre.
Fig. 7. Vertical section of the same, similarly enlarged.

XXI.—*Descriptions of some new Longicornia, chiefly Asiatic and African.* By FRANCIS P. PASCOE.

THE following is a list of the species described below:—

CERAMBYCIDÆ.

Philus ophthalmicus. North Borneo*.
Prothema variicornis. Labuan.
Nenenia aurulenta. Melbourne.
Epipedocera leucaspis. Sarawak.

LAMIIDÆ.

Anexodus aquilus. North Borneo.
Thylactus longipennis. Old Calabar.
Chreostes Oberthürii. Zanzibar.
Sympiodes varius. Delagoa Bay.
Tanylamia melanura. Madagascar.
Dystasia nubila. Sumatra.
Apomecyna albopicta. Delagoa Bay.
Zeargyra vidua. North Borneo.

Philus ophthalmicus.

P. angustus, rufo-brunneus; elytris subtestaceis; oculis supra approximatis; prothorace cylindrico carina laterali obsoleta. Long. 12 lin.

Hab. North Borneo.

Narrow, reddish brown, the elytra inclining to testaceous;

* Those from North Borneo were collected by a Mr. Lewis, and are without precise locality.

head above and in front with a deep groove; eyes very large, approximating above; antennæ (♂) rather longer than the body; prothorax nearly cylindrical, slightly transverse; elytra finely pubescent, each with three inconspicuous longitudinally elevated lines; body beneath and legs with slightly scattered hairs.

This species differs from its congeners in its cylindrical prothorax (at least in the male) and the approximation of the eyes above. In the females in this genus the antennæ are usually only half the length of the body; but in the Formosan *P. pallescens*, according to Mr. Bates, the antennæ of the female are also longer than the body. The genus is placed by Lacordaire in the Prionidæ; it is evidently a transitional form, in which the prothoracic carina, one of the principal characters of the family, ceases to be of more than specific value.

Prothema variicornis.

P. oblonga, atra; antennæ articulis sexto ad nonum flavidis; elytris in medio fasciis duabus, linea humerali obliqua suturaque postice, flavescentibus. Long. $4\frac{1}{2}$ lin.

Hab. Labuan.

Oblong, opaque black, minutely and closely granulate above; antennæ with the sixth to the ninth joints pale fulvous; prothorax not longer than broad; scutellum covered with a pale fulvous pubescence; elytra scarcely broader than the prothorax in the middle, an oblique stripe at the shoulder, two narrow bands in the middle, and a sutural stripe from the posterior band composed of a pale yellowish pubescence; legs slender, black; tarsi with pale whitish hairs; body beneath with a close silvery pubescence.

Form and general appearance of *P. humeralis*, but with a shorter, minutely granulate prothorax, narrower elytra, with a somewhat different arrangement of pubescence, and antennæ of two colours.

NENENIA.

Caput antice quadratum, postice angustius, fronte excavatum. *Antennæ* filiformes. *Oculi* tenuiter granulati, subreniformes, lobo superiore parum producto. *Prothorax* ad latera tuberculatus. *Elytra* parallela. *Pedes* mediocres; *femora* vix elevata; *tarsi* sublineares; *coxæ anticæ* subglobosæ, contiguæ; *posticæ* approximatæ. *Segmenta* abdominis longitudine æqualia.

I cannot find a satisfactory place for this genus in Lacordaire's system. It seems to come nearest to *Phalota*, but the two lobes of the eye are not widely apart and only connected

by an almost obsolete line, the upper lobe being represented by a short prolongation from the lower lobe, and terminating *behind* the antennary tubercles. The anterior coxal cavity is open and the intermediate closed. *Xystæna* has coarsely faceted eyes, and in Lacordaire's system would probably have found a place near.

Nenenia aurulenta.

N. oblonga, subdepressa, testacea, pube aureo-sericea omnino vestita; prothorace basin versus tuberculis duabus munito. Long. 4 lin.

Hab. Australia (Melbourne).

Oblong, subdepressed, testaceous, everywhere clothed with a silky gold-tinted pubescence; antennæ as long as the body, third and fourth joints equal, the fifth rather longer, the remainder about equal, but not longer than the third or fourth; prothorax scarcely broader than long, with two well-marked tubercles near the base; elytra parallel, each with two finely raised lines; posterior tarsi slightly longer than the intermediate.

Epipedocera leucaspis.

E. subdepressa, obscure sanguinea; antennis, pedibus marginibusque elytrorum atris; scutello pube argentea dense vestito; elytris breviusculis, modice punctatis, apice singulorum acute bispinoso. Long. 2½ lin.

Hab. Sarawak.

Rather depressed, dull red; antennæ, legs (tarsi testaceous), and margins of the elytra, as well as the apical third, opaque black; scutellum closely covered with a silvery pubescence; prothorax rounded, closely punctured; each elytron terminating in two rather long acute spines; abdomen reddish testaceous.

One of Mr. Wallace's captures, but from some oversight omitted in my 'Longicornia Malayana.'

It differs from *E. cruenta* in its less transverse prothorax, shorter and more parallel elytra, and other characters. The genus appears to me to be more allied to the "Pyresthides" than to the "Clytides," the anterior cotyloid cavities being closed in behind, and the antennæ being more or less dilated.

ANEXODUS.

Caput inter oculos profunde excavatum; *oculi* reniformes, sat grosse granulati. *Antennæ* basi approximatæ; *scapus* magnus, apice

unilateraliter productus; articulo secundo elongato, tertio quartoque æqualibus et brevioribus. *Prothorax* oblongus, robustus, dente parvo utrinque instructus. *Elytra* ovata, prothorace haud latiora. *Pedes* modice elongati; *tibiæ* intermediæ integræ.

A remarkable genus, whose nearest ally seems to be *Microtragus*, but distinguished by the comparatively great length of the second joint of the antennæ, a character, I believe, unique among the Longicorns. The prothorax is unusually large, and the scutellum is sufficiently conspicuous.

Anexodus aquilus.

A. anguste oblongus, fuscus, prothorace utrinque vitta obscure alba notato; elytris vage punctatis et tuberculatis. Long. 5½ lin.

Hab. North Borneo.

Narrowly oblong, dark brown, a dull white stripe on each side of the prothorax; above finely and densely pubescent, with minute scattered black setæ intermixed; antennæ shorter than the body, the scape much thickened, as long as the next three joints together; prothorax much longer than broad, the pubescence darker and somewhat velvety above, the lateral tooth small and rather before the middle; scutellum transverse and rounded behind; elytra rather more than half as long again as the prothorax, sparingly punctured and with several small tubercles, and a more prominent one on each side at the base; body beneath and legs with a pale or whitish pubescence.

Thylactus longipennis.

T. elongatus, fuscus, supra pube grisea nigrescenti-varia obtectus; elytris elongatis, parallelis, apice singulorum rotundato-producto, dorso lineis longitudinalibus duabus curvatis munitis. Long. 13 lin.

Hab. Old Calabar.

Head, prothorax, base of the elytra, and a well-limited oblong patch at the sides dark brown; body beneath and legs with a greyish pubescence; antennæ dark brown, not longer than the body, the antennary tubers approximate at the base; front of the head concave, and a deep linear longitudinal groove behind; prothorax with two small tubercles near the apex, the lateral tooth large and prominent.

This species has somewhat the facies of *Xylorhiza*, but it agrees better technically with *Thylactus*.

Chreostes Oberthürii.

C. robustus, fuscus, pube grisea dense tectus; elytris, basi excepta, impunctatis, in medio vitta obliqua pallide brunnea signatis, humeris paulo productis, regione humorali minus pubescente et grosse punctata. Long. 14 lin.

Hab. Zanzibar.

Facies and characters mostly as in *C. ephippiatus*, but with a different pattern on the elytra, and further differentiated by a large triangular and nearly naked patch, very coarsely punctured, on the shoulder, the rest of the elytra impunctate except a few slight punctures by the scutellum; the oblique stripe commences near the suture, and is continued outwards and downwards nearly to the margin. The eyes in this genus are small, not nearly reaching to the mouth, as in its ally *Phryneta*.

Named after M. René Oberthür, of Rennes, to whom I am indebted for this and many other Coleoptera.

SYMPIODES.

Caput breve, antice transversum; *tuberculis antenniferis* fere obsoletis. *Antennæ* basi distantes; *scapus* brevis, ovalis, articulis 3–10 cylindricis. *Oculi* minores, reniformes, grosse granulati. *Prothorax* transversus, lateribus rotundatis. *Elytra* prothorace multo latiora, modice convexa. *Pedes* breves, validi; *femora* inermes; *tibiæ* compressæ, intermediæ extus sinuatæ; *tarsi* lati; *unguiculi* approximati. *Mesosternum* subquadratum.

Although with a different facies, this genus agrees in most of its characters—as, indeed, may be said of some others—with *Enaretta*; the tibiæ, however, are shorter and greatly compressed, the claws approximate, the mesosternum more nearly quadrate, and the joints of the antennæ from the third to the tenth are cylindrical—that is, not narrower towards the base. The eye-facets are unusually few.

Sympiodes varius.

S. brevis, pube rufo-brunnea griseo-varia vestitus; prothorace in medio paulo transversim elevato; elytris apicem versus angustioribus, postice tuberculis sex munitis, utrinque ad marginem macula fusca notatis. Long. 2½ lin.

Hab. Delagoa Bay.

Short and somewhat broad, covered above with a reddish-brown pubescence, varied with pale greyish; head slightly concave between the eyes; antennæ much shorter than the

found also in *Gyaritus* and *Axinyllium*, from which this genus is differentiated in the two lobes of the eyes being completely disconnected. The type of the genus has perhaps more the facies of *Oloessa*, which, however, belongs to another group; it is more or less covered with a silky pubescence, and, especially beneath the antennæ, with long erect setæ, the legs included.

Zeargyra vidua.

Z. modice robusta, nitida, atra; elytris dimidio basali et apice læte argenteis, basi tuberculis duabus fasciculatis munito. Long. 2¼ lin.

Hab. North Borneo.

Moderately stout, glossy black, the elytra with the basal half and large portion of the apex covered with a close silvery pubescence; head not broader than the prothorax, flat between the antennary tubers, which are widely apart; antennæ longer than the body, the third joint not quite so long as the fourth, but both longer than the scape; prothorax slightly longer than broad, narrowing towards the base and rather coarsely but not strongly punctured, the middle of the disk with two well-marked, nearly erect, approximate spines, the spines at the sides pointed and conical; scutellum transverse, rounded behind; elytra subovate, declivous towards the apex, striate-punctate, with two elevated fasciculate tubercles at the base, behind which the elytra are slightly depressed; legs with a white pubescence, the claws brownish.

XXII.—*Description of a new* Gerbillus *from Sind.* By JAMES A. MURRAY, Curator, Kurrachee Municipal Museum.

Gerbillus Gleadowi, sp. nov.

Fur soft and long, rufous-fawn above, white below, the two colours sharply defined; fur of the upper parts rufous-fawn for one third the terminal length and slaty to the base. A broad supercilium in front and the sides of the face white, limiting the rufous-fawn on the nose to a narrow band. A small rufous cheek-patch present. Ears slightly concave in front near the tip and convex at the base; the tip is rounded off; behind they are convex; laid forward they reach halfway to the hind edge of the eye; on the outside they are clad with short

rufescent brown hairs, and on the inside with greyish; on the margin there is a decided fringe of brown hairs, except at the base in front, where the hairs are slightly longer and white. Whiskers white, except the upper series of 3–4 on each side, which are brown; the longest is 2 inches in length. Feet, tarsi, and greater portion of thighs white. Thumb of fore foot with a nail; only a single foot-pad; no pads on the hind feet, the palmar surfaces of which, as well as the fore feet, are covered with hairs. Tail uniform pale isabelline, slightly paler or nearly white below near the tip. Pencil brown above, white below. Mammæ four pairs, two inguinal and two pectoral. Upper incisors grooved.

The following are the measurements of the nine specimens collected:—

	1. ♂.	2. ♀.	3. ♀.	4. ♂.	5. ♀.	6. ♂.	7. ♂.	8. ♀.	9. ♀.
	in.	in.	in.	in.	in.	in.	in.	in.	in.
Head and body	$3\frac{3}{8}$	$3\frac{3}{8}$	3	$3\frac{3}{8}$	3	$3\frac{1}{4}$	$3\frac{1}{2}$	$3\frac{3}{8}$	$3\frac{1}{2}$
Tail to end of vertebræ	$5\frac{1}{4}$	5	$4\frac{5}{8}$	5	5	5	$4\frac{13}{16}$	$5\frac{1}{4}$	5
Pencil	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{5}{16}$	$\frac{1}{2}$
Height of ear from orifice ..	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{3}{8}$
Breadth of ear	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{1}{4}$	$\frac{1}{4}$
Fore foot and claw	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{3}{8}$
Hind foot and claw	$1\frac{3}{16}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{3}{16}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{16}$	$1\frac{3}{16}$	$1\frac{3}{16}$
Longest whisker	$1\frac{15}{16}$	$1\frac{5}{8}$	$1\frac{3}{4}$	$1\frac{7}{8}$	$1\frac{3}{4}$	$1\frac{7}{8}$	2	$1\frac{5}{8}$	$1\frac{5}{8}$

This species was collected by Mr. F. Gleadow, my indefatigable correspondent, at a place called Beruto, 15 miles S.W. of Rehti, in the Mirpur Drahrki Taluka of the Rohri district in Upper Sind. Mr. Gleadow says that the specimens were all got in one place, far away from any village, and that the species burrows in sand-hills under the roots of *Calligonum polygonoides* and *Leptadenia Jacquemonti*.

The species appears to me to be near *Gerbillus nanus*, Blanford (Zool. E. Persia), but differs from it in having fairly clad ears, well clad palmar surface of both fore and hind feet, as well as in size. The head and body are longer than in *nanus*, and the tail also, which measures in some as much

as 5¼ inches without the pencil. The ears, again, are smaller (0·43 × 0·25 against 0·45 × 0·3). The fore foot too is much smaller, while the hind foot measures 1·12 inch against 0·9.

P.S.—The following are the dimensions of the skull of no. 2:—

	inch.
Length from occiput to end of nasal bones	1·12
Length from lower margin of foramen magnum to alveolar border of premaxillaries	0·90
Breadth across zygomatic arches................	0·58

The nearest described form appears to be *G. hirtipes*, Lataste, from Algeria, which, to judge by the description, differs in having the tail throughout tawny above and white below.—W. T. B.

XXIII.—*A Reply to M. de Betta's Remarks on* "Rana temporaria." By G. A. Boulenger.

Through the kindness of M. de Betta, I have recently received a pamphlet entitled "Sulle diverse forme della *Rana temporaria* in Europa e più particolarmente nell' Italia" (Venezia, 1885), in which he expresses it as his opinion that the various forms of European land-frogs hitherto distinguished are specifically identical. After all that has been published to demonstrate that the term "*Rana temporaria*," in its old sense, is merely collective and embraces a number of species characterized not only by form and coloration, but by important anatomical and physiological peculiarities, M. de Betta's views do not seem to me to be in accordance with the progress of science; and as the above-cited paper, from the pen of the veteran Italian herpetologist, is likely to influence many who have as yet failed to form an opinion on the subject, or to encourage superficial treatment of the question of species and their geographical distribution, I cannot allow it to pass without a reply.

At the present day, to mention from any given locality in the Palæarctic Region "*Rana temporaria*," in its widest sense, is worth as much as to record "the Lizard" or "the Newt." I am not afraid of going too far in stating that the differences between the forms of "*Rana temporaria*" are as great as those between *Lacerta ocellata*, *L. viridis*, and *L.*

agilis, or *Coronella austriaca* and *C. girondica*, or *Vipera berus*, *V. aspis*, and *V. ammodytes*, or *Bufo calamita* and *B. viridis*, all closely allied species, which are, I believe, admitted as such by M. de Betta, but which might just as well be united, being connected by intermediate forms, and not one of their characters, taken by itself, being absolutely constant.

With one exception, M. de Betta's arguments are too vague to be refuted. The one point on which he is quite precise is the statement that all male *Ranæ temporariæ* have vocal sacs, and that therefore no distinctive characters are to be found in the presence or absence of these organs. I have examined a great number of males of *R. agilis*, *R. Latastii*, and *R. iberica* *, and I can affirm that internal openings to vocal sacs are constantly absent in those three species, whilst they are readily distinguished in *R. temporaria* and *R. arvalis* †. This is certainly a most important distinctive character. I therefore expressed my surprise to M. de Betta, and requested him to send me a specimen of *R. agilis* or *R. Latastii* showing the vocal sacs. His answer has been that his statement was not based upon direct investigation, but chiefly taken from Thomas's and Fatio's publications, in which all land-frogs are said to be provided with internal vocal sacs.

M. de Betta's pamphlet is chiefly a review of the literature on the group of *Ranæ temporariæ*, in which he contrasts the opinions hitherto expressed in favour of or against their specific distinctness. However, this review is very incomplete, and I regret to see that the author ignores the contributions of Leydig, Pflüger, Born, and others, all favourable to the specific distinctness, which are surely of greater weight in the examination of this question than the fact that Günther, in 1858 (Catal. of Batr. Sal.), from the examination of a few specimens in spirit, made at a time when very little had been published on the subject, did not admit *R. arvalis* as a species. But I am glad he has alluded to this high authority, as it

* *R. iberica* is now well represented in the Natural-History Museum, Dr. Gadow having collected numerous specimens during a recent journey in Portugal. Of *R. Latastii* there are several specimens, for which I am indebted to Dr. Camerano.

† It should be understood that by "absence" of vocal sacs systematic authors have hitherto had in view the absence of openings inside the mouth indicating the presence of such sacs. But, as observed by Leydig, this does not imply the total absence of those organs, and the Batrachians held to be devoid of vocal sacs, such as *Rana agilis*, *Bufo vulgaris*, *Discoglossus*, *Bombinator*, &c., are by no means dumb, and have the faculty of inflating the throat.

affords me the opportunity of informing him that Dr. Günther, since he has had living specimens of *R. arvalis* and *R. agilis* for examination, now also adopts the view that they deserve specific distinction.

And now I have only to add that, of the numerous specimens from various European localities which have passed through my hands since the publication of my Revision of the *Ranæ temporariæ*, I have not met with a single one which I have not been able to pronounce at first glance as belonging to one or the other of the European species.

XXIV.—*Description of a new Brazilian Species of* Hesperomys. By OLDFIELD THOMAS, Natural-History Museum.

AMONG a small series of mammal-skins sent over from Rio Janeiro to Mr. E. Gerrard, Jun., occurs a specimen representing a striking new species of *Hesperomys*, which I propose to call

Hesperomys rufescens, sp. n.

General colour rich orange-rufous all over, both above and below, the hairs everywhere slaty blue at their bases and rufous at their tips. Underside only slightly lighter than upper. Ears short, scarcely projecting beyond the fur, thickly covered with rufous-brown hairs. Feet yellow; toes whitish, fifth hind toe to end of second phalanx of fourth. Tail of medium length, unicolor, thinly covered with brown hairs, which form an inconspicuous pencil at the tip.

Skull with the cranial portion very large; interorbital region broad. Supraorbital edges square, not ridged. Incisors dark orange above, yellow below.

Measurements of the typical skin (female):—Head and body 94 millim., tail 93, hind foot 20·0, ear (above crown) (c.) 7·0.

Skull: basal length (c.) 25·5, zygomatic breadth 16·8, length of face 15·0; brain-case, length (c.) 13·0, breadth 14·2; interorbital breadth 5·1; nasals, length 9·0; back of incisors to m^1. 8·0; length of molar series 4·9; palatal foramen, length 4·3.

Hab. Rio Janeiro.

Although superficially much resembling the smaller species of the *Oryzomys* section of *Hesperomys*, this species has only one really near ally, viz. *H. bicolor*, Tomes*, a native of Ecuador, which differs from it by its white belly and naked

* P. Z. S. 1860, p. 217.

ears, and of whose more important characters Mr. Tomes has given an excellent description. The two species together seem to belong to rather a synthetic type, combining the external characters of *Oryzomys* with the cranial ones of *Rhipidomys*, to which latter, under the name of *Myoxomys*, Mr. Tomes referred his species *, calling it, however, the "least typical species" of that group.

I have not, unfortunately, been yet able to examine a spirit-specimen of either *H. bicolor* or *H. rufescens*, so that I cannot describe the characters of the foot-pads, palate-ridges, or mammæ; and I will therefore follow Mr. Tomes's example and leave the two species in *Rhipidomys*, of which, as that gentleman said, they certainly form the least typical part.

XXV.—*Contributions to a Knowledge of Malayan Entomology*. Part IV. By W. L. Distant.

The following undescribed butterflies have been recently received from several valued correspondents, and will be all figured in the Appendix to the writer's 'Rhopalocera Malayana.'

Rhopalocera.

Fam. Papilionidæ.

Subfam. *Papilioninæ*.

Papilio Egertoni, n. sp.

Female. Anterior wings above blackish, the nervures and nervules margined with dull obscure greyish: posterior wings above bluish grey, the cell and the area from costal margin to lower subcostal nervule almost totally dark bluish black and with a double series of spots of the same colour placed between the nervules, the uppermost and discal series smallest, consisting of four spots, of which the largest is subquadrate and placed between the lower subcostal and the discoidal nervules; the outer series marginal and larger than the discal spots; abdominal area dark bluish grey and with two small spots of the same colour placed beneath cell and divided by the second median nervule; fringe very narrowly ochraceous. Anterior wings beneath as above, but with the greyish markings paler and brighter and with oblique

* P. Z. S. 1861, p. 284.

greyish streaks in cell; posterior wings paler and brighter than above; the blackish basal area continued inwardly to submedian nervure. Body above with the head and anterior portion of pronotum pale buff-yellow, remainder of pronotum black; abdomen ochraceous, with a greenish tinge, its base black and with two lateral rows of black spots on each side; body beneath with the head, thorax, and legs black, the abdomen beneath darker ochraceous than above; palpi pale buff-yellow.

Exp. wings 150 millim.

Hab. Perak (*coll. W. Egerton*).

This remarkably distinct species, of which the colour of the head and anterior portion of the pronotum is not the least peculiar character, has the broad anterior wings (in female) of the *Erebus* group, whilst the markings of the posterior wings somewhat remotely resemble those of *P. polymnestor*, Cram.

Fam. Lycænidæ.

Deramas, gen. nov.

This genus is closely allied to *Poritia*, but differs by possessing *five* subcostal nervules in the anterior wings; of these the first is very short, emitted at about one third before the end of cell, and joins the costal nervure; second emitted nearer first than third; third from end of cell; fourth bifurcating from third at about half its length; fifth bifurcating from third about midway between base of fourth and apex of wing.

Deramas livens, n. sp.

Wings above dark cœrulean-blue; anterior wings with the neuration, costal, cellular, and apical areas, outer margin narrowly to outer angle, and inner margin narrowly dark fuscous; posterior wings with a cellular tuft of long hairs, costal and abdominal areas, posterior margin, and a more or less continuous series of marginal spots placed on the nervules dark fuscous. Wings beneath pale brownish ochraceous; both wings with a narrow, linear, much waved and dislocated castaneous fascia, between which and outer margin the colour is much suffused with greyish; posterior wings with a short, narrow, strongly waved linear blackish fascia at anal angle. Body and legs more or less concolorous with wings.

Exp. wings 30 millim.

Hab. Singapore (*coll. Capt. Godfery*).

Nacaduba kerriana, n. sp.

Wings above pale lavender-blue; anterior wings with the costal margin narrowly and the outer margin more broadly fuscous; posterior wings with the outer margin fuscous, and with marginal fuscous spots separated by the median nervules, which are divided from the outer margin by narrow, greyish, linear marking; tail-like appendages fuscous, with the apices greyish white. Wings beneath pale greyish brown; anterior wings with the following whitish fasciæ:—one crossing cell just before apex, and extending from subcostal nervure to near inner margin; a short discocellular fascia just beyond end of cell, preceded by a small spot between the second and third subcostal nervules; these are followed by a fascia which nearly crosses the whole breadth of wing, commencing at second subcostal nervule and extending to near inner margin, the outermost fascia being shorter and commencing at lower subcostal nervule terminates on second median nervule; outer margin broadly whitish, containing a double series of dark fuscous spots, extreme margin dark fuscous; fringe brownish: posterior wings crossed by a series of whitish fasciæ, the outer margin as on anterior wings with two marginal black spots, which are separated by the second median nervule and are irrorated with bluish scales and preceded by ochraceous shading. Body above and beneath more or less concolorous with wings; legs fuscous streaked with greyish.

Exp. wings 35 millim.

Hab. Singapore (*Major Kerr, coll. Dist.*).

Lycænesthes æthiops, n. sp.

Wings above dark violaceous blue; wings beneath greyish mottled with purplish. Anterior wings with the following dark fuscous markings:—a broad basal streak beneath costal nervure extending to about middle of cell, where it is joined to a large spot which crosses and extends beneath cell; a large discocellular spot at end of cell; a curved fascia between end of cell and outer margin, extending from the second subcostal nervule to the second median nervule; a somewhat similar fascia extending from second median nervule near end of cell to near inner margin; paler narrow marginal and submarginal fasciæ containing a large, round, dark spot between the second and third median nervules. Posterior wings with the following dark markings:—four basal spots, two large spots beyond cell divided by the upper subcostal nervule, a marginal series of smaller dark spots and paler discal spots, of which the most prominent are a transverse one at end of cell, and a transverse

waved series of rounded ones; all these spots are margined with greyish. Body and legs more or less concolorous with wings.

Exp. wings 33 millim.

Hab. Penang (*Rev. L. Biggs, coll. Dist.*).

The peculiarity of this species is in its Ethiopian appearance, its most closely allied species being the West-African *L. larydas*, Cram.

XXVI.—*The Polyzoa of the Adriatic: a Supplement to Prof. Heller's 'Die Bryozoen des adriatischen Meeres,'* 1867. By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Plates IX. & X.]

THE material on which the following papers are based has been placed in my hands by my friend Dr. Pieper, of Olfen, who has given much attention to both the Hydroida * and the Polyzoa of the Adriatic. I propose to include in them a list of the Polyzoa which occur in Dr. Pieper's collection, but are not recorded by Heller in the above-mentioned work, with descriptions of new species and varieties, and critical notes on such as are imperfectly known.

Suborder CHEILOSTOMATA.

Family Æteidæ.

ÆTEA, Lamouroux.

Ætea recta, Hincks.

On stone, weed, &c.

Range. Bahusia; Southern Norway; Great Britain (south-west and west, to Shetland); Ireland (west coast); Naples (*Waters*).

Ætea truncata, Landsborough.

Abundant. The erect form attains a very luxuriant growth; the marked dwarf variety (*pygmæa*), which occurs on the British coasts, is also present in the Adriatic.

* We are indebted to him for a very valuable series of papers on the Hydroida of the Adriatic, published in successive numbers of the 'Zoologischer Anzeiger' for 1884 (nos. 162–165 inclusive), which constitute a supplement to Heller's 'Die Zoophyten &c. des adriatischen Meeres' (1868).

Range. Bahusia; Southern Norway; Britain (chiefly south and west); Madeira.

Family **Eucratiidæ**, Hincks.

EUCRATEA, Lamouroux.

Eucratea chelata, Linnæus.

On other Polyzoa.

Range. Southern Norway; France (south-west); Bay of Cadiz; Great Britain and Ireland (generally distributed); Australia.

Family **Notamiidæ**, Hincks.

SYNNOTUM, nov. gen.

Der. σύν, together, and νῶτον, the back.

Gen. char.—*Zoarium* consisting of erect, slender, bifurcating shoots, which are attached by a mass of tubular fibres given off from the base of the primary cells. *Zoœcia* in pairs, joined back to back, each pair connected by tubular prolongations with the pair next but one below it *, elongate, expanding from the base upward (of the Eucratean type), the front occupied by a membranous area (aperture); sessile lateral avicularia and an articulated avicularium between the cells in each pair at the summit. *Oœcium* wanting.

This extremely interesting form has been already described and figured by Dr. Pieper †. He has referred it to the genus *Gemellaria*, an opinion in which, after an examination which proves to have been a very insufficient one, I fully concurred. At the same time Dr. Pieper notes the presence of avicularia and a peculiarity in the mode in which the pairs of cells are connected as points which might prove to be of generic value. He seems to have overlooked the fact (as I certainly did myself) that the structure of the zoarium is essentially the same as in *Notamia*, and that each pair of cells is united by tubular prolongations, not with the next in succession, but with the one below it, as in that genus. The zoœcia of the present form are of the Eucratean type and bear a close general resemblance to those of *Gemellaria*; they are also placed back to back as in that genus. Dr. Pieper is quite right in suggesting that *Synnotum* may perhaps be regarded "als Verbindungs-Glied zwischen *Gemellaria* und *Notamia*."

* This clause is included in the family character.

† Jahresber. Westfal. Prov. Ver. vol. ix. pp. 43-48, Taf. ii.

It is undoubtedly a transition-form and one of the highest interest.

Avicularia are present under two forms—one placed laterally and in much the same position as the similar appendage in *Notamia bursaria*; the other, which is much more highly developed, occupies a central place at the summit of each pair of cells.

The lateral avicularium is perfectly sessile and is destitute of the stem, which gives to that of our "Shepherd's purse coralline" its striking resemblance to a tobacco-pipe.

In other respects the two seem to agree, so far as my specimens enable me to judge. In *Synnotum* the lateral appendage is only present on one of the cells in each pair, and occurs alternately on the right and left of the zoarium; it is placed immediately above the top of the cell on the inner side and close upon the double-stem, which embraces the pair of cells below it.

The second form of avicularium (the median) belongs to the articulated division and is a fully developed "bird's head." It is placed immediately above the pair of cells in the line of their junction, and seems to be attached to the tubular connexion by which the cells are linked together. It is borne on a tall and rather stout peduncular support and is of a globular shape (very slightly produced in front); the beak terminates in a short, somewhat curved, spike-like extremity. The peduncle on which the avicularium is borne is unlike the ordinary form, and at first sight suggests a doubt whether the appendage is movable (articulated) or merely pedunculate. I have met with a single case, however, in which it had been swung back and remained with the oral surface turned uppermost.

The association of articulated avicularia with lower forms in one and the same species is, I believe, a new fact. It is interesting to remember that in *Notamia* we find the fixed form of the appendage, which probably comes "on the whole nearest to the movable 'bird's head,' and constitutes the most direct link between the two classes of avicularium." In the present member of the Notamian family this fixed form has been partially replaced by the higher, and the two developmental stages stand side by side in the same organism.

The differences between *Notamia* and *Synnotum* lie primarily in the structure of the zooecium and secondarily in the character and disposition of the avicularia.

The name which I have adopted (*Synnotum*) was suggested by Dr. Pieper as appropriate should his species prove to be entitled to generic rank.

Synnotum aviculare, Pieper.

Gemellaria avicularis, Pieper, *loc. cit.*
Notamia avicularis, Waters, "Supplemental List of Polyzoa from Bay of Naples," Journ. Roy. Microscop. Soc. ser. 2, vol. v. (1885).

Zoarium minute, slender, of delicate texture, glossy, simple in habit, consisting of long stems, which bifurcate at rather distant intervals. *Zoœcia* in pairs, back to back, elongate, expanding gradually upwards from the base, which is much attenuated and tube-like, somewhat prominent above; the aperture occupying more than two thirds of the front, narrowing to a point below, the margin thin and unarmed; *lateral avicularia* small, sessile, placed at the top of a cell, on the inner side, adnate, developed alternately on the right and left of the zoarium, widening from the base upward, with a minute beak; *median avicularia* articulated, capitate, placed at the top of each pair of cells on the central line, subglobular, smooth, the beak very slightly produced, with a sharp spike-like extremity.

Hab. On the underside of stones, Nullipore, &c.

Range. Adriatic (*Pieper*); Bay of Naples (*Waters*).

In the present form the shoots originate in a pair of rudimentary zoœcia, which are much shorter than the mature cells and are not prolonged below the aperture. They are destitute of avicularia, but give off from their lower extremity a number of long tubular fibres. From these primary zoœcia a normal pair is developed, which immediately bifurcates, giving origin to two separate lines of cells. In the fork between the two branches is placed a capitate avicularium. After an interval bifurcation takes place again, but it is not carried further in any specimen which I have examined. Above each bifurcation there is only a single zoœcium, as in *Notamia*, instead of the usual pair. Generally the course of development is the same in *Synnotum* as in *Notamia bursaria*; but in the latter the primary cells are borne on a stem which rises from a "rather stout creeping tube."

There seems to be little difference in general structure between the sessile and capitate avicularia, though they are very dissimilar in size and appearance. They agree in minute details and little change is needed to convert the one into the other. The stemmed avicularium of *Notamia*, and especially the larger form of it which occasionally occurs, marks a distinct advance towards the articulated form, and is intermediate between the two appendages of *Synnotum*.

A remarkable feature of the present species is the number of very long tubular fibres which are given off from all regions

of the zoarium. They originate from a small circular prominence, which is always either upon or in close proximity to the central stem. Two or three sometimes occur in connexion with a single pair of cells.

Family **Chlidoniidæ**.

Chlidonia, Savigny.

Chlidonia Cordieri, Audouin.

Thickly investing the stem of a seaweed.

Range. Australia; Cape York; the Canaries; Egypt; Tyre; Bay of Tunis; Nice; Naples; coast of Calvados.

Family **Cellulariidæ**.

Scrupocellaria, Van Beneden.

Scrupocellaria Bertholletii, Audouin. (Pl. IX. figs. 1, 2.)

Scrupocellaria Bertholletii, Savigny, Egypt, pl. xi. fig. 3.
? *Scrupocellaria capreolus*, Heller, *op. cit.* p. 11, pl. i. fig. 1.

Zoarium of rather delicate habit, white and glossy, dichotomously branched, forming small tufts. *Zoœcia* rather long, five in an internode, clavate, widest above and narrowing gradually downwards; aperture elongate-oval, with a thin margin, occupying about two thirds of the front; three spines on the outer margin above, on the inner a tall spine a little way down the side, and sometimes a small one above it; about halfway down the cell on the inner margin an antler-like scutum *, frequently wanting, often merely bifurcate and in its simplest condition acicular; *lateral avicularium* small, placed immediately behind the three outer spines; on the front of each cell just below the aperture a large sessile *avicularium*, tumid towards the base, the mandibular region facing towards the aperture; mandible acute, bent at the tip, directed outwards; beak of moderate size, not abruptly bent. *Vibracular cell* wedge-shaped, narrow and bluntly pointed below,

* Mr. Busk, following Smitt, has adopted the term *fornix* in place of *operculum*, which has been assigned by general consent to the oral valve. At the same time he plainly indicates his preference for *scutum* ('Challenger' Report, p. 15, footnote), and as in framing scientific terminology we are not bound by authority or precedent, but are free to select the terms which seem to be most fitting, I shall venture to side with Mr. Busk's evident preference against his practice and use the latter term, which seems to me indubitably the better, to designate the protective appendage with which the cell is furnished in this and other species.

expanding upwards; aperture sloping inwards and extending almost across the cell, seta long and very slender. *Oœcium* simple, rounded above, somewhat contracted towards the orifice; surface smooth and shining, punctured, the oral arch marginate.

There can be little doubt, I think, that this is the *Acamarchis Berthollettii* of Savigny's work, a species which has not yet been identified. Busk, in his Brit. Mus. Cat., placed it doubtfully amongst the synonyms of his *Scrupocellaria diadema*; but in his 'Challenger' Report the latter is referred to *Crisia ciliata*, Audouin. There is a complete agreement between Savigny's figure and the species from the Adriatic, extending to the minuter details.

There is also, I think, the greatest probability that Heller's *Scrupocellaria capreolus* was founded on specimens of the present form, though both his diagnosis and figure are too slight to give us the information we require for a certain identification.

It is pretty evident that the bi- or trifurcate spine of his description is really the *scutum*; this is sufficiently indicated by its position; and if so there is a complete agreement in this element of structure between his species and *S. Berthollettii*. The characters of the aperture and the disposition of the spines in *S. capreolus* also point to the identity of the two forms. The spine on the inner margin a short distance above the scutum is especially characteristic. The lateral avicularium is small and an inconspicuous feature, as in *S. Berthollettii*. On the other hand, the oœcium of the latter is not mitriform, as that of *S. capreolus* is represented to be in the figure, but both are punctured; the front avicularia are apparently wanting in Heller's species.

On the whole there seems to be ground for believing in the identity of the two forms. *S. Berthollettii* is common amongst the material which has come under my notice, and would probably not be overlooked by one who was investigating on the spot the fauna of the Adriatic. I have met with no other form which could have suggested Prof. Heller's description or figures.

There is a curious irregularity in the development of the scutum in the present species. Very often it is absent altogether or present only in very rudimentary condition on a few cells. Commonly it occurs as a bifurcate spine-like process, and only in rare instances, so far as my experience goes, does it present the appearance shown in the figure (Pl. IX. fig. 1). As Savigny's figures represent it as universally a mere bifurcate spine, the feeble development of this appendage

is probably characteristic of the species. In its earliest stage it is simply acicular.

The spines are variable in number, but the full normal equipment seems to be three on the outer and two on the inner margin.

The front avicularia are usually present and often of gigantic size, covering almost entirely the portion of the cell below the aperture. In some cases, however, they are quite insignificant; internodes occur occasionally on which all the appendages are reduced to mere pygmies. I have seen a considerable section of the stem, including several internodes, on which scarcely one was present and none strongly developed. It is quite possible therefore that they might escape the notice of an observer who had not the opportunity of examining a number of specimens.

Family **Bicellariidæ.**

Bugula, Oken.

Bugula calathus, Norman.

This species occurs in the Adriatic and is at once recognized by its characteristic habit of growth and its light colour when dried, apart from the minute structural differences by which it is separated from *B. flabellata.*

Range. Britain (south-west) and Channel Islands.

Bugula ditrupæ, Busk. (Pl. IX. fig. 3, 4.)

The form which is represented in figure 4, Plate IX., is probably referable to this species, though it differs in some points from Busk's description. The cells can hardly be regarded as "fusiform;" they taper gradually and slightly downward, but are not contracted above. The spines, which are very constant in number and arrangement, do not correspond with those of *B. ditrupæ* as described. On the outer margin, which is somewhat folded in, are two spines, one of them suberect and pointing upwards, the other originating close to its base and curving slightly outwards. A similar pair is placed at the top of the inner margin. Immediately behind the outer pair on the top of the cell is a tall spine of much stouter build than the rest, whilst another, of more slender proportions, rises about halfway between the lateral groups. This is a very characteristic armature, and it is, as I have said, remarkably constant. Busk assigns four spines to his species, three on the outer and one on the inner margin;

but he may possibly have only examined cells furnished with the ovicell (in his figure every cell bears one), and in this case two of the spines would probably be covered. Looking to the general resemblance of the two forms, I have no hesitation in identifying them.

On some of the specimens from the Adriatic the *primary cell* is present (Pl. IX. fig. 3). The shoot commences with a simple stem of some length, which gradually widens upwards from the very slender base, and terminates above in a single cell. This cell is rudimentary, having an aperture which is very short as compared with that of the ordinary zoœcia, and surrounded by a number of tall spines, which originate outside the margin. The pair of opposed spines is also present on each side at the top. At the back of the primary cell two other zoœcia are developed which diverge and give origin to two branches. There is a slight peculiarity in these cells; an additional spine is present on the margin of the aperture between the bottom of it and the avicularium, but in all other respects they are normal. The specimens which I have seen are detached, so that nothing can be known of their habitat. Mr. Busk's are all on the shells of *Ditrupa*.

Range. Madeira.

Bugula gracilis, Busk.

Characteristic specimens occur on seaweed, but showing no trace of the curious appendages with which the variety *uncinata*, mihi, is furnished *. At the same time a careful examination of them leaves little doubt on my mind of the specific identity of *Bugula gracilis* and the form *uncinata*.

Range. Madeira (form *uncinata*); Britain; North America.

Bugula plumosa, Pallas, form *aperta*, n. (Pl. IX. fig. 6.)

Zoarium somewhat rigid in habit, branches rather long, fan-shaped, divided and subdivided dichotomously, disposed subspirally round the stem. *Zoœcia* biserial, alternate, elongate, narrowing slightly downward; aperture occupying fully three fourths of the front, rounded below, the outer margin more or less bent inward, carried out above into a strong subconical spine, and bearing a small *avicularium*, which is placed a short distance from the top. *Oœcium* extremely shallow,

* 'British Marine Polyzoa,' vol. i. p. 86.

entirely open in front, and scarcely sheltering the membranous sac enclosing the embryo, placed at the top of the cell and overhanging the orifice.

In most of the structural elements there is a complete resemblance between this form and the well-known *B. plumosa.* It is less flexible and graceful in habit than the "soft-feathered coralline," and the cells are perhaps flatter and less turned inwards than in that species; but these are trifling differences, and in the absence of the oœcium no one probably would hesitate to rank it under Pallas's name. The ovicells, however, of the two forms are essentially dissimilar: that of *B. plumosa* is subglobular and of the usual type; that of the present form is a mere shield slightly hollowed out and perfectly open in front (Pl. IX. figs. 6 *a*, 6 *b*). It resembles that of *B. purpurotincta*, but seems to be even more rudimentary. The difference is undoubtedly important, and in most cases would be accounted distinctive; but in view of the general structural agreement it seems better to rank the present form under *B. plumosa.*

Bugula spicata, n. sp. (Pl. IX. fig. 5)

Zoarium simple and rather stiff in habit, about ¾ inch high. Shoots originating from a stem composed of a number of tubular fibres united together; branches tall, much divided and subdivided dichotomously, spreading. *Zoœcia* in from two to four series, elongate, straight above, of about the same width throughout (rectangular); aperture occupying nearly the whole front, narrowing downward, the lower extremity pointed, a strong spike-like spine on the outer margin above, and two, placed one in front of the other, on the inner. *Avicularium* on the outer margin, almost close to the top, well rounded behind, beak short, the extremity slightly bent. *Oœcium* terminal, rounded, smooth.

The zoœcia are generally biserial, but are often quadriserial towards the upper part of the branches. I can only speak doubtfully of the size and habit of growth, as I have not seen more than one or two specimens, which might be immature, but the minute characters are sufficiently distinctive.

Bugula simplex, n. sp. (Pl. IX. fig. 7.)

Zoœcia in from two to five or six series, alternate, elongate, subrectangular, rather broad, very slightly contracted below, top of the cell straight; aperture extending almost to the bottom, broad as the cell above, narrowing slightly below,

margins thin, a little turned inwards, at the top on each side a short spinous projection. *Avicularium* placed a very short distance below the top, rather small, (as seen from above) very slender, elongate, straightish, running out to a fine point in front, the free extremity of the beak very short and slightly bent. *Oœcium* terminal, very wide (wider than the top of the cell), shallow, almost semicircular, marginate round the base, the front wall composed of slight membranaceous material.

B. simplex belongs to the same section of the genus as *B. flabellata.* The ovicell is extremely shallow, the basal portion slightly hollowed out and surrounded by a rim-like margin, and with a filmy membranous covering closing in the upper part of the front. It seems to be intermediate between the normal oœcium and the very rudimentary form which we have in *Bugula plumosa* form *aperta.* The zoarium, in the only specimen examined, is about half an inch in height; the branches which divide dichotomously and are somewhat flabellate originate together at the top of a short stem and form a cup-shaped growth.

DIACHORIS, Busk.

Diachoris hirtissima, Heller, form *cylindrica*, n.

Dr. Pieper's collection contains several specimens of an exceedingly interesting variety of this species. Two forms of the zoarium are known in this genus: one in which the cells are more or less decumbent and repent, not indeed adnate to the surface over which they spread, but attached to it by means of tubular fibres and adhesive disks; and another in which they are united so as to constitute erect, bilaminate fronds. To these must now be added a third, in which the zoœcia are aggregated, so as to form *erect, cylindrical, branching stems* of considerable height, rooted by a mass of tubular fibres. These fibres, in the variety of the present species to which I have given the name *cylindrica*, pass upwards, erect and free, carrying lines of the interconnected cells in such a manner as to form cylindrical stems. The fibres occupy the hollow of the cylinder, and the cells, which lie closely together in line, constitute the walls. The shoots are somewhat loosely compacted and of lax habit, and towards the base the cylinder is sometimes imperfect. They grow in dense clusters and are much branched dichotomously, attaining a height of about two inches. The transformation which the species has undergone in this variety is really remarkable. It is a *Vincularia* amongst the Bicellariidæ, and may teach us the true

systematic value of such peculiarities of growth in a natural system.

Hab. On Nullipores.

Range. Cape Verd Islands: var. *robusta*, Hincks, Algiers.

Family **Cellariidæ**.

CELLARIA, Lamouroux.

Cellaria Johnsoni, Busk.

This seems to be a common species in the Mediterranean.

Range. Madeira; Algiers; Bay of Naples; Shetland.

Family **Membraniporidæ**.

Subsection *a. Zoarium flexible and foliaceous.*

FLUSTRA, Linnæus.

Flustra securifrons, Pallas.

This species is included in Heller's list, but he has not noted certain peculiarities which belong to the southern form of it. There are commonly two rather strong spines on the cell placed one on each side at the top, and the avicularia, in a large proportion ot cases, are set obliquely *.

The front of the oœcia is closed in by a membranous curtain, and in those from which the embryo has escaped there is usually at the top of it in the centre an opening somewhat in the shape of a reversed triangle. The definiteness and uniformity in the position and form of this orifice seem to show that it is due to some special structural arrangement. It has all the appearance of having been caused by the action of a muscle attached to a point in the middle of the upper margin of the membrane, which, in contracting, has drawn a portion of it downward, and so provided for the egress of the embryo. A similar contrivance has been demonstrated in the ovicell of *Bicellaria ciliata*.

In *Flustra papyracea* an analogous opening exists.

Range. Britain (chiefly north); Norway; Spitzbergen; South Labrador; Naples.

* These variations have been mentioned by Waters in his 'Bryozoa of the Bay of Naples.

Subsection *b. Zoarium calcareous, adnate or erect.*

MEMBRANIPORA, De Blainville.

Membranipora operculata, n. sp. (Pl. IX. fig. 8.)

Zoœcia large, arranged with great regularity in quincunx, subclavate; aperture elongate-oval, occupying more than three-fourths of the front, wholly membranous; margin thin, unarmed, not granulated, the inner edge often set with minute conical projections; oral valve distinct, of a firm chitinous substance, edged with a white line, arched above, lower margin arcuate, slightly produced at each side into a point; the portion of the cell below the aperture smooth, bearing in the centre and close to the margin of the aperture a mound-like elevation, on the summit of which is a short sharply-pointed chitinous spine *Oœcium* (?).

Hab. Incrusting seaweed.

The remarkable point in this handsome species is the structure of the oral valve. The small semicircular opening in the front wall of the cell, with its membranous lid, which is characteristic of the *Membraniporæ*, is here replaced by a comparatively solid and well-defined operculum, which remains unchanged in dried specimens when the membranous wall around it has completely shrivelled up. At the same time there is no solid framework isolating it from the surrounding wall, as in the genus *Euthyris*; it lies bedded in the membrano-gelatinous covering of the aperture, conspicuous from its well-defined light-coloured outline.

The oral structure in the present species may be regarded, from one point of view, as intermediate between that of the ordinary members of the genus and the more specialized form of it which is found in *Euthyris* amongst the *Flustræ* and *Thairopoa*, MacGillivray, amongst the *Membraniporæ*. But I have reason to believe, though I have not been able to determine the details with certainty, that the more highly organized operculum is in this case associated with peculiarities in the internal structure of the oœcium. I hope to be able to supply further particulars in a future paper.

Membranipora Dumerilii, Audouin.

This species sometimes occurs with a much larger number of spines than have been noticed on British specimens.

There is commonly a tall slender spine at the bottom of the cell which bends inwards over the aperture; occasionally too there are several on the sides and as many as six at the top.

Range. Britain; Scandinavian seas; France (south-west); Bay of Naples.

Family Cribrilinidæ.

CRIBRILINA, Gray.

Cribrilina punctata, Hassall, var. (Pl. IX. fig. 9.)

A very pretty variety of this species is not uncommon. The centre of the front wall immediately under the projecting lower lip is occupied by a raised area, which is surrounded by a smooth border extending to the margin of the cell. The edge of this area is marked by a line of small prominences, and the outside wall occupied by a number of little alcoves hollowed out in the face of it. The field of the area is perforated. The pointed avicularia, one at each end of the thickened and mucronate lower margin and one on the summit of the ovicell, are present as in the more normal form.

May not this be the *Lepralia cribrosa* of Heller?

The specimens which have been sent me from the Mediterranean as Heller's species are undoubtedly referable to *C. punctata*.

Family Myriozoidæ (part.), Smitt.

SCHIZOPORELLA, Hincks.

Schizoporella unicornis, Johnston. (Pl. X. figs. 2, 3.)

Heller records this species and a number of varieties. One remarkable form, however, he does not seem to have noticed, which exhibits a very marked modification of the orifice and contrasts strongly with another form (also found in the Adriatic) in this and other points.

Schizoporella unicornis, form *longirostris*.
(Pl. X. fig. 2.)

Zoœcia large, often somewhat quadrate, moderately convex, surface reticulato-punctate, glossy; orifice arched above, lower margin straight, with a central sinus, contracted above (but without prominent points at the entrance), the cul-de-sac below round; peristome elevated and thickened, except in front, an umbo below the orifice. *Avicularium* on one side of the orifice, more or less raised, sometimes mounted on an elevated mound, with a very long beak, base triangular, above it very narrow and of about equal width throughout (narrowing

very slightly towards the point); mandible corresponding exactly with the fixed portion, much curved inwards towards the extremity. *Oœcium* prominent, rounded, ridges radiating from the centre towards the base, the furrows between them punctured.

This variety exhibits two striking peculiarities.

The first and most important is the conformation of the orifice, which will be best understood by comparing the cell of this form with that of another (Pl. X. fig. 3) which also occurs in the Adriatic and is probably the common one on the British coasts. The orifice of the latter is suborbicular above, with a broad and open sinus (occupying about half the lower margin or more), not constricted at the entrance, but widest there, and narrowing slightly downwards, though still broad and rounded at the bottom.

The second peculiarity of the present variety lies in the avicularium, which is of great length and much attenuated (Pl. X. figs. 2 and 2 *a*) above the broad triangular base. The slender mandible is much curved above. The area behind the mandible is semicircular and entirely closed in by membrane. The avicularium of the other form is short, suberect, with a triangular mandible slightly bent at the tip. The differences in the appendage are of less significance as it is more liable to modification, and intermediate forms frequently occur. But the variation in the orifice is certainly striking.

The *ansata* variety gives us something of an intermediate form; but I have met with nothing that makes a near approach to the present.

Schizoporella lineolifera, n. sp. (Pl. IX. fig. 10.)

Zoœcia disposed in radiating lines, small, ovate, depressed below, slightly elevated above; sutures well defined, a distinct raised boundary-line; surface thickly and regularly punctured, pores stellate; orifice suborbicular, narrowed and produced below, peristome not raised, immediately in front of it an umbo bearing on the top a small pointed *avicularium*, mandible directed straight outwards. *Oœcium* ample, broad and rounded above, contracted towards the orifice; surface punctured, the opening closed by the operculum; a raised line round the base.

At one time I was inclined to think that this might be the *Lepralia rudis* of Manzoni, a Pliocene species ('Briozoi Pliocenici Ital.' 1869); but there is hardly ground for the identification.

Schizoporella magnifica, n. sp. (Pl. X. fig. 1.)

Zoœcia quincuncial, large, ovate, rather depressed, sutures shallow; surface reticulate, no boundary-lines; orifice suborbicular, with a deep pointed sinus on the lower margin, wide at the entrance, tapering off to a point below, a small notch on each side just below the opercular denticles; peristome unarmed, not elevated; on each side of the orifice, close to the top of the cell, a pointed *avicularium*, erect, with a triangular mandible, slightly produced, a semicircular orifice at the base of the beak; at each side on the front of the cell, a little below the orifice, a similar avicularium, erect, borne on the inner surface of an elevated boss. *Oœcium* much elongated, ample and rounded above, tapering off towards the orifice, where it is much contracted, and ends in a subtubular opening which barely overhangs the top of the oral valve, surface reticulate.

Hab. Incrusting stones &c.

A splendid form, of which the remarkable ovicell is the great feature.

Schizoporella serratimargo, n. sp. (Pl. X. figs. 6.)

Zoarium erect, bilaminate, branched; branches wide, flat, compressed, extremities rounded. *Zoœcia* quincuncial; when young, distinct, ovate, moderately convex (sutures shallow), the oral region raised, surface dense, uneven, entire or with a few marginal punctures; orifice oval, with a small sinus on the lower margin, operculum thickened on each side, so as to give the appearance of a depression down the central line; peristome elevated and often much thickened, bearing four spines at the top; the older cells crowded, confused, highly calcified, primary orifice deeply depressed, a large secondary orifice somewhat produced in front, almost the whole front of the zoœcium occupied by a large spreading elevation bearing a pointed avicularium. *Oœcium* rounded, subimmersed, closely united to the cells about it, with a smooth entire surface and a large cleft in front, wide at the opening and tapering upwards. Along the edge of the branches a line of gigantic avicularia with bluntly-pointed mandibles directed outwards.

I have not met with perfect specimens of this fine species, and am therefore unable to give the size or precise habit of growth. The broad flat branches are characteristic.

Schizoporella Pallasii, Heller (sp.). (Pl. X. figs. 7.)

Heller places this species in the genus *Eschara*. It bears a curious superficial resemblance to some of the forms which

are ranged under the *Adeonella* of Busk, a somewhat miscellaneous group which, as Waters has already suggested, must be dismembered. But it has no real affinity with the species which are related to *Adeona*, and which would properly belong to the genus *Adeonella* if that genus is to be maintained. It seems to me to be a *Schizoporella*, the characters of which are somewhat masked by the curious bridge-like structure which crosses the cell immediately below the orifice. This materially affects the appearance of the species, but does not seem to have any special significance. It is due to the union of the risings on which the two lateral avicularia are placed, a little below the orifice; they grow together and form an arch across the front of the elevated peristome, leaving an opening below, through which the primary orifice and the sinus are visible.

The same structure is met with in *Schizoporella biturrita*, mihi, on which Busk has founded his genus *Gephyrophora*, with the specific name *polymorpha* ('Challenger,' Report). In this case the "bridge," it would seem, is almost as often absent as present. The specimens on which my description was founded were entirely destitute of it, and I have met with others in the same condition. The structure does not appear to be a very essential one. Apart from this peculiarity, *S. biturrita* is a very typical member of the genus to which I refer it, and it certainly seems to be too trivial to stand as the sole distinctive character of a generic group. The orifice of *S. Pallasii* is arched above, with a straight lower margin and a central sinus of moderate size. Waters (who identifies this species with the *Eschara polystomella* of Reuss) ranks it under *Adeonella*, an opinion in which I cannot concur.

Range. Bay of Naples.

Schizoporella atrofusca, Busk. (Pl. X. figs. 4, 5.)

This species is identified by Waters ('Polyzoa of Bay of Naples') with *Lepralia cucullata*, Busk (Brit. Mus. Cat.). But if the description and figure of the latter are to be trusted the two must be distinct. It is altogether destitute of the large and very marked sinus, with the strong denticular projections at the entrance, which are so characteristic of the present form. In point of fact the latter is *Lepralia atrofusca*, Busk, described in the Quart. Journal of Microscopical Science, vol. iv. 1856, p. 178, but without figure. The description though brief is sufficiently characteristic, and leaves no doubt as to the form intended. The variety with the thickened and elevated peristome in front (Pl. X. fig. 5), which may be distinguished as form *labiosa*, has smaller

cells than normal Mediterranean and Mazatlan specimens, and is much altered in appearance by the modification of the mouth, but is essentially identical with the present form.

The cells of this species are commonly covered with an epidermis, which partially conceals the punctures. Two small round prominences are present on the operculum just within the sinus.

Range. Bay of Naples; Mazatlan: form *labiosa*, Arabian sea.

Schizoporella auriculata, Hassall. (Pl. X. figs. 8.)

A form which has hitherto been referred to this common species, and which is distinguished by its large spatulate avicularia, occurs abundantly amongst the dredgings from the Adriatic. The peculiar avicularium is associated with a very distinctive form of orifice (Pl. X. fig. 8 *a*). The ordinary cell of *S. auriculata* is represented in fig. 8, Pl. X., and a comparison of the two will show the marked differences between them. The general shape of the orifice and the character of the sinus are quite dissimilar. The form *spathulata* seems always to bear the spatulate avicularium, or an *elongate oval* avicularium, which is the earlier stage of the former. In this stage the beak has a trifoliate form (Pl. X. fig. 8 *b*), with a small central projection on the inferior margin. The avicularium of the normal form is, I believe, always circular and very small. It may, I think, be doubtful whether the variety is not entitled to specific rank. It seems to be a southern form, occurring in Britain on the south-west coasts, in the Adriatic, and the Bay of Naples. The point will be left for further investigation.

EXPLANATION OF THE PLATES.

Plate IX.

Fig. 1. *Scrupocellaria Bertholletii*, Audouin.
Fig. 2. Ditto. Dorsal surface.
Fig. 3. *Bugula ditrupæ*, Busk. Showing the primary cell.
Fig. 4. Ditto.
Fig. 5. *Bugula spicata*, n. sp. 5 *a*. Ovicells. 5 *b*. Avicularium.
Fig. 6. *Bugula plumosa*, Pallas, form *aperta*, n. 6 *a*. Side view of the ovicell. 6 *b*. Cell and ovicell, front view.
Fig. 7. *Bugula simplex*, n. sp.
Fig. 8. *Membranipora operculata*, n. sp.
Fig. 9. *Cribrilina punctata*, var.
Fig. 10. *Schizoporella lineolifera*, n. sp. 10 *a*. Orifice.

Plate X.

Fig. 1. *Schizoporella magnifica*, n. sp.
Fig. 2. *Schizoporella unicornis*, Johnston, form *longirostris*. 2 *a*. Avicularium.

Fig. 3. *Schizoporella unicornis*, Johnston. Normal.
Fig. 4. *Schizoporella atrofusca*, Busk.
Fig. 5. *Schizoporella atrofusca*, form *labiosa*.
Fig. 6. *Schizoporella serratimargo*, n. sp. Marginal cells. 6 *a*. Mature cells and ovicell. 6 *b*. Marginal avicularium. 6 *c*. Oral valve. 6 *d*. Nat. size.
Fig. 7. *Schizoporella Pallasii*, Heller. 7 *a*. Marginal cell, showing sinus.
Fig. 8. *Schizoporella auriculata*, Hassall. Showing ordinary form of orifice. 8 *a*. Variety *spathulata*. 8 *b*. Avicularium of this variety in early stage.

XXVII.—Hystricrinus, *Hinde, versus* Arthroacantha, *Williams: a Question of Nomenclature.* By George Jennings Hinde, Ph.D., F.G.S.

In the 'Annals' for March 1885, p. 158, I proposed the term *Hystricrinus* for a genus of Crinoids with movable spines in place of *Arthroacantha*, Williams *, on the ground of the resemblance of this latter term to *Arthracanthus*, Schmarda †, which had been previously employed for a genus of Rotatoria. The essential similarity of these terms seemed to me to bring the case so very clearly within the tenth rule of the British Association Committee ‡, that "a name should be changed when previously applied to another group which still retains it," that it did not seem necessary to advance any arguments to justify the course adopted. But Messrs. Wachsmuth and Springer, in part iii. of their lately issued "Revision of the Palæocrinoidea" §, p. 116, reject my term *Hystricrinus* and reinstate Williams's name, on the ground that "*Arthroacantha* is a different word from *Arthracanthus* although of the same etymology and of similar construction, and there are other names of recognized standing in natural history which bear a closer resemblance to prior names than this" (p. 117).

As the question is of more than the mere personal interest as to who should be the author of a generic name, and as it should be decided in accordance with the rules made to prevent confusion in scientific literature, and with the general practice of reputable scientific authors of the present day, I venture to state the reasons which appeared to me to be sufficient not only to justify, but to necessitate, the substitution of another term for that of Professor Williams. I may first premise that the remarks which may be made upon the invalidity of Prof. Williams's name are not intended in any

* 'Proceedings of the American Philosophical Society,' 1883, p. 84.
† Denkschr. k.-k. Akad. d. Wiss. Wien, vol. vii. 1854, p. 12.
‡ 'Report of the Thirty-fifth Meeting of the British Association for the Advancement of Science,' Birmingham, 1865, p. 33.
§ 'Proceedings of the Academy of Natural Sciences, Philadelphia,' July 1885, p. 116 (separate copy).

way to reflect upon this gentleman, who, in a letter to me of the 13th May last, acknowledging the receipt of my paper on *Hystricrinus*, says :—" I agree with you in the impropriety of my generic name [i. e. *Arthroacantha*] and shall adopt yours. It was a provoking accident which caused me to overlook that single page of names applied to Rotatoria in Marshall's index."

As Messrs. Wachsmuth and Springer recognize the rules of zoological nomenclature of the British Association Committee, it may be desirable to give quotations from the particular one bearing on this subject* :—

" It being essential to the binomial method to indicate objects in natural history by means of *two words* only, without the aid of any further designation, it follows that a generic name should only have *one meaning*—in other words that two genera should never bear the same name. . . . When these cases occur the later of the two duplicate names should be cancelled and a new term, or the earliest synonym, if there be any, substituted. . . . It is, we conceive, the bounden duty of an author, when naming a new genus, to ascertain by careful search that the name which he proposes to employ has not been previously adopted in other departments of natural history. By neglecting this precaution he is liable to have the name altered and his authority superseded by the first subsequent author who may detect the oversight. . . . We submit therefore that a name should be changed which has before been proposed for some other genus in zoology or botany, or for some other species in the same genus, when still retained for such genus or species."

Applying the above rule to the present case, we have the names :—

> *Arthracanthus*, Schmarda, 1854. From ἄρθρον, joint, and ἄκανθα, spine, for a genus of Rotatoria, characterized by movable spines, which serve as oars to the animal.
>
> *Arthroacantha*, Williams, 1883. Also from ἄρθρον, joint, and ἄκανθα, spine, for a genus of Crinoids characterized by movable spines.

It is very evident that both these generic terms have one and the same meaning, and this fact would, according to the rule quoted, require that the later one should be changed. If we turn now to the proper construction of these words, there is no doubt that, in accordance with the regular method of forming compound Greek words, Schmarda's term is correct, and that Williams and Wachsmuth and Springer are orthographically in error in retaining the "*o*" in *Arthroacantha*,

* *Loc. cit.* p. 34.

which must therefore be deleted. We have then the same word for the two genera; but in the one case it is placed in the masculine and in the other in the feminine gender. It is difficult to see the reason why Schmarda should have adopted the masculine termination *-us* instead of retaining the feminine termination *-a* of the Greek ἄκανθα, and exception might fairly be taken to the change, and it would be open to any one to alter the *-us* into *-a*, and thus corrected the word is precisely identical with the corrected *Arthracantha*, Williams. Schmarda does not seem to have followed any rule respecting the terminations of the generic names, for in the same group he employs *Hexarthra*, *Listrion*, and *Typhlotrocha*; and it may be urged that Agassiz has also modified the terminal *-a* of the same Greek word into *-us* in the case of the numerous genera of fossil fishes which are based upon spines.

Admitting, however, that *Arthracanthus*, Schm., may be retained in the masculine form, it seems to me that the later term *Arthrăcantha*, Will., judging according to the spirit of the rule of the British Association, cannot be valid. It is substantially the same word and unequivocally it has the same meaning as Schmarda's term. To admit it would be the same as allowing that the same Greek word would be applicable to three distinct genera, according to its masculine, feminine, or neuter termination!

Again, if the term were specially suitable to a genus of Crinoids, one might be disposed to allow the infraction of the rule in favour of retaining it; but even Messrs. Wachsmuth and Springer * are constrained to acknowledge that it is "injudiciously chosen."

These same authors, moreover, are not merely content with endeavouring to upset the generic term *Hystricrinus*, but they also assert that the species which I described and figured in the 'Annals' as *Hystricrinus Carpenteri* is "probably a synonym of *Arthroacantha punctobrachiata*, Williams" †. To this I reply that Prof. Williams never professed to describe, and in fact did not describe, a species of this name, that the name is a MS. one of Prof. Hall, and that until the forms have been sufficiently described and published, the species has no recognized existence and cannot be a synonym of *H. Carpenteri*.

Prof. Williams, in the paper referred to above, under the title "On a Crinoid with movable Spines," described a single species which he designated *Arthroacantha ithacensis* ‡. He compared this species with a specimen in the Museum of Cornell University, which had been photographed by Prof. Hall, and the photograph, with the MS. name *Platycrinus?*

* *Op. cit.* p. 116. † P. 119.

‡ 'Proceedings American Philosophical Society,' 1883, p. 85.

punctobrachiatus appended to it, was privately circulated, but *never published.* Notwithstanding this, Prof. Hall made a claim to the species; and Prof. Williams, unwilling to disoblige this veteran palæontologist, did not describe the form, but only made the following remarks respecting it*:—

"The arms, the shape of calyx, and the plates that were preserved corresponded in general with the *A. Ithacensis*, but the tubercles on the calyx plates are finer, more numerous, and the pitting very indistinct, and the basal plates are relatively larger than in the typical specimens of that species. Hence we are led to believe that the Hamilton species is distinct from the Chemung specimens, *and even if it were properly described and published*, it is probably safe to regard it as a distinct species. Although the specimen shows *no trace of the free spines*†, the nature of the tubercles leaves little doubt of a generic identity with *Arthroacantha Ithacensis*, and the Hamilton form may be called *Arthroacantha punctobrachiata*." Again, on p. 86:—"This species [i. e. *A. ithacensis*] differs from the *Arth. punctobrachiata* of the Hamilton group in the more distinct and less numerous tubercles on the surface of the calyx plates; the smaller size of the tubercles leads to the inference that the spines were smaller in the Hamilton form; the calyx plates were apparently thicker in the Chemung species, and the second and third plates of the specimen of *Arth. punctobrachiata* are higher than those of *Arth. Ithacensis*."

One needs hardly ask the question seriously, whether the above general remarks and inferences, mostly of a negative character, can be regarded as sufficient to define a species. Under the twelfth rule of the British Association it is stated, "two things are necessary before a zoological term can acquire any authority, viz. definition and publication. Definition properly implies a distinct exposition of essential characters, and in all cases we conceive this to be indispensable." There is evidently no distinct exposition of the essential characters of a species to be obtained from the cursory observations of Prof. Williams respecting Hall's MS. specimen; and it is clear that if this author had intended to have described *P. punctobrachiatus*, Hall, MS., he would have furnished all the particulars of form, the exact measurements, and the figures, in the same manner as in the species *A. ithacensis*, which he professed to describe, and did so in a very able and satisfactory manner, notwithstanding that his specimen was only a negative cast of the form.

I maintain therefore that Messrs. Wachsmuth and Springer are certainly in error in asserting that *P. punctobrachiatus* is a good species and must be credited to Williams. It seems to

* *Ibid.* p. 83.

† The *italics* are mine.

me that these authors are doing Prof. Williams an injustice in endeavouring to foist upon him the authorship of a species to which he lays no claim, and which he has not taken steps to establish.

When Prof. Hall properly describes (and publishes) the typical specimen which bears his MS. name of *P. puncto-brachiatus*, it will then be seen if it is identical with *Hystricrinus Carpenteri*; and in this latter eventuality his MS. name must lapse.

Notwithstanding the scanty imperfect notice of the MS. *P. punctobrachiatus* given by Williams, and the absence of any published figure, Messrs. Wachsmuth and Springer profess to be able to recognize with confidence specimens of it from the Hamilton group of the Province of Ontario; but they are unable to determine their identity with my *Hystricrinus Carpenteri*, though this latter form has been minutely described and figured! Still further, these authors recognize the spines of *P. punctobrachiatus*, though none were present in the typical specimens of this form; and yet they cannot tell if they are similar to those of *H. Carpenteri*, although these latter have been carefully figured to scale!

Further comment on the remarkable insight and the peculiar views of Messrs. Wachsmuth and Springer respecting zoological nomenclature is needless. I venture to believe that it has been sufficiently shown that both the generic terms *Hystricrinus* and the species *H. Carpenteri* have been formed in accordance with the rules of the British Association; and I therefore append the following summary as an emendation of that given by the above-named authors:—

HYSTRICRINUS, Hinde (=ARTHROACANTHA, Williams, previously occupied).

1885, Ann. & Mag. Nat. Hist. ser. 5, vol. xv. p. 158.

1883. *Hystricrinus* (*Arthroacantha*) *ithacensis*, Williams, sp. Type of the genus. Proc. Amer. Phil. Soc. April, p. 85, with plate.—Upper Devonian, Chemung group. Ithaca, New York.

1885. *Hystricrinus Carpenteri*, Hinde, Ann. & Mag. Nat. Hist. ser. 5, vol. xv. p. 162, with plate and woodcut.—Middle Devonian, Hamilton group. Arkona, Ontario, Canada.

(Besides the above, Prof. Williams mentions a specimen to which Prof. Hall has given the MS. name *Platycrinus punctobrachiatus*. The form has not yet been described and published, and cannot therefore at present be included in the genus. According to Williams, the type-specimen is from the Hamilton group, but no locality is given.)

BIBLIOGRAPHICAL NOTICES.

Fossil Crinoids.

Paléontologie Française ou description des fossiles de la France.—Terrain jurassique, tome xi. première partie: *Crinoïdes,* par M. P. de Loriol. Paris: 1882–1884. Pp. 627, pls. 1–121.

Revision of the Palæocrinoidea.—Part III. *Discussion of the Classification and Relations of the Brachiate Crinoids, and Conclusion of the Generic Descriptions.* By Charles Wachsmuth and Frank Springer. First Section. Extracted from the 'Proceedings of the Academy of Natural Sciences,' July 28, 1885. Philadelphia, 1885. Pp. 138, pls. iv.–ix.

When reviewing Mons. de Loriol's monograph upon the fossil Crinoids of Switzerland in 'Nature' for August 4, 1881, we mentioned that he was engaged upon a similar work which would deal with the Neocrinoids found fossil in France. The results of his study of some of those which occur in the Jurassic rocks have now been published as the first part of the eleventh volume of the 'Paléontologie Française.' We think that the indefatigable author has every reason to be satisfied with his work, which cannot fail to be of the utmost use to all students of the Neocrinoidea, and indeed to every palæontologist who wishes to have the means of naming the numerous fragments of Apiocrinidæ which are so common in Jurassic strata.

The work before us, which consists of 627 pages of text with an atlas of 121 plates, is, however, much more than a mere enumeration of species, with descriptions of those previously unknown to science. The first thirty pages are devoted to a good general introduction, which touches upon the peculiarities of the Palæozoic Crinoids as well as of those of later date, with which the author is more immediately concerned; and it is illustrated by seven plates, which contain figures of the Pentacrinoid larva and of the more remarkable among the recent Crinoids which were known to the author at the time when he commenced his work. The student is thus brought face to face with the only method which can lead him to a right understanding of his collections; and it would be well if Mons. de Loriol's example were more frequently followed by those so-called palæontologists who think that life is too short for the study of the living representatives of their fossils. Every specialist could name one or more of these empirical writers, who are often most valuable as careful and zealous collectors, but come to utter grief when they attempt to deal with questions of structure. Of them may it truly be said "the evil that men do lives after them." For the old error, though corrected again and again, is continually being reproduced in text-books and elsewhere. The snake is never really killed, but only scotched, and the advance of real scientific knowledge is hindered in consequence.

Mons. de Loriol's introduction is followed by a chapter on classification, in which Zittel's arrangement of the true or brachiate Crinoids, the Cystids, and the Blastoids as orders of the class Crinoidea is adopted. But Palæocrinoidea and Neocrinoidea are wisely

used as subordinal designations instead of the misleading terms Tessellata and Articulata; and in accordance with this proceeding the Marsupitidæ and Uintacrinidæ are restored to their proper places among the Neocrinoids; while a new family, Bourgueticrinidæ, is very rightly established for *Bourgueticrinus*, *Rhizocrinus*, and *Bathycrinus*, genera which differ considerably from the typical Apiocrinidæ.

The remaining and by far the largest portion of the volume contains descriptions of the Jurassic Eugeniacrinidæ and Holopidæ, and of the three principal genera of Apiocrinidæ, viz. *Guettardicrinus*, *Apiocrinus*, and *Millericrinus*. Eleven species of *Eugeniacrinus* are described, including four new ones, *E. mayalis* being from the Lias and the remainder from the Oxfordien. *Phyllocrinus* is represented by seven species, three being new, and *Tetracrinus* by one; while a new genus, *Eudesicrinus*, is established for a remarkable type which has been referred both to *Plicatocrinus* and to *Eugeniacrinus*, and seems likely to find its true position among the Holopidæ. Much new and valuable information is given about the singular type *Cotylecrinus*, which has also been found in the Dorsetshire Lias; and the curiously abnormal *Gymnocrinus* is described from better material than was available when the author worked out the fossil Crinoids of Switzerland. Besides *Guettardicrinus* fifteen species of *Apiocrinus*, four of which are now described for the first time, occur in the French Jurassic strata, while the genus *Millericrinus* is represented by no less than sixty-four species, of which twenty-six are new to science. About one fifth of them are only known by their stems; but these are as a rule very well defined, and seem to afford good specific characters.

The most interesting morphological point which has been brought out by Mons. de Loriol's work is the presence of small underbasals in two species of *Millericrinus*. They do not appear at all upon the exterior of the calyx, as they rest upon the central part of the enlarged uppermost stem-joint and are concealed by the basals outside them. But they seem to be well differentiated, though relatively small; and it is quite probable that they will ultimately be found to occur in other species of the genus, though, as Mons. de Loriol says, they are certainly absent in many which he has been able to examine in detail, as his excellent figures show.

All working palæontologists must be grateful to him for this most useful book and will welcome the appearance of the next volume, which will deal with the Pentacrinidæ and Comatulidæ, families which are both well represented in the French Jurassic strata, as indeed also in those of our own country.

The name of Mr. Charles Wachsmuth, of Burlington, Iowa, is so well and so favourably known to every student of the Pelmatozoa that the appearance of a new section of the 'Revision of the Palæocrinoidea' by himself and Mr. F. Springer is an event of considerable interest. Parts I. and II. were published in the years 1879 and 1881 respectively. The first and most important section of Part III., which appeared at the close of last year, contains a discussion of the classification and relations of the brachiate Crinoids, together

with the final revision of the generic descriptions in one of the three primary groups into which the Palæocrinoids are divided by the American authors. This portion of the work appears to us to be much the most satisfactory one. In the extent and accuracy of his personal acquaintance with the wonderfully complex generic types which are presented by the Palæocrinoidea Mr. Wachsmuth has no equal, we had almost said no second; and the immense mass of detailed information which he possesses concerning the intricate composition of calyx and vault in the Actinocrinidæ, Platycrinidæ, and Rhodocrinidæ is clearly and explicitly set forth in Parts I. and II. and in this first section of Part III. of the 'Revision.' The order Palæocrinoidea is divided by himself and Mr. Springer into three suborders, the first of which includes the three families just mentioned and all other Palæocrinoidea "in which the plates of the test are solidly united by suture, and in which the lower arm-plates are incorporated by means of interradial plates so as to form a part of the calyx." For this group the name Camarata is proposed, while the Articulata (the Ichthyocrinidæ of Part I.) include "those families in which the plates of the test are united by loose ligaments or muscles, and in which they are somewhat movable." Lastly the group Inadunata (corresponding on the whole to the Cyathocrinidæ of Part I.) "is proposed for all Palæocrinoidea in which the arms are free above the first radials and which have five single interradials, located ventrally." The authors state that "these groups are not only well defined in nature, as shown by the fact that they are so readily recognized, but they are also most convenient for all descriptive and comparative work." In this remark we entirely concur, and we fully believe that the classification which the authors propose will stand the test of future research. It has grown up gradually during the many years of Mr. Wachsmuth's experience as a collector, and we doubt if any palæontologist will be able to improve upon it.

The view which the authors take of the Crinoids with regard to the other Echinoderms appears to us, however, to be a less satisfactory one. They follow the writer in adopting Leuckart's separation of the stalked Echinoderms under the name of Pelmatozoa, but only rank this group as a class equivalent to Urchins and Starfishes. The spirit of Leuckart's classification is thus entirely ignored, though it is partially followed in the letter, and we are taken back in principle to the grouping of the older systematists, in which Crinoids, Cystids, and Blastoids were all thrown together under the term Crinoidea, regardless of the fact that Miller's very explicit definition of this term implies the presence of articulated arms upon the radials, and that these appendages are absent in both Blastoids and Cystids.

Leuckart's separation of the Pelmatozoa from Urchins and Stellerids on the one hand, and from Holothurians on the other, has been abundantly justified by the physiological and morphological researches of the last twenty years; and the difference of a Crinoid from an Urchin or Starfish is far greater than their difference from one another, as was long ago pointed out by Professor Huxley.

Messrs. Wachsmuth and Springer, however, follow Zittel and de Loriol, and regard Pelmatozoa, Urchins, and Stellerids as equivalent classes of Echinoderms, which (as just remarked) is little more than a nominal change on the classification of forty years ago.

Following the principles of Burmeister's classification they divide the Pelmatozoa into two subclasses, Anthodiata and Brachiata or true Crinoidea. The first contains the two orders Cystids and Blastoids, while the second falls naturally into Palæocrinoids and Neocrinoids. There is more to be said for this classification than for that which we have just criticized. But we cannot help thinking that the Cystids and Blastoids are more divergent in character than the Palæocrinoids and Neocrinoids are, and that, as suggested by Professor Huxley, they deserve to be ranked as classes of Echinoderms equivalent to the Crinoids. This course was taken by the writer in the 'Challenger' Report, and has since been adopted by Ludwig, the leading German authority on Echinoderms, who also follows Leuckart, Ray Lankester, and others in giving the Pelmatozoa the rank of a branch and not merely that of a class of Echinoderms.

On p. 75 Messrs. Wachsmuth and Springer profess their inability to point out a single character of either Crinoids, Cystids, or Blastoids "that is not found exceptionally in one of the other groups." They admit, however, that "probably neither Blastoids or Cystids had appendages united by paired muscular bundles" (p. 78); and this is one of the essential characters of the true or brachiate Crinoids. Furthermore, there are at least two strong points of difference which distinguish the Blastoids from the Cystids. The hydrospires of the latter group are very irregularly disposed, while those of the Blastoids are grouped with the utmost regularity in five (or in one genus only four) pairs, which are limited to the radial and deltoid plates and occupy the interradial portions of the calyx, with their slits parallel to the ambulacra; and the small azygos basal of the Blastoid is always situated in the left anterior interradius. In all Palæocrinoids which resemble the Blastoids in having an unequally tripartite base, with one possible exception, the small plate is in the right anterior interradius; and we are not aware that any such symmetry is observable in the few Cystidean genera which have only three basal plates, except perhaps in *Cryptocrinus cerasus*. There are other characters, such as the ambulacral structures of Blastoids, which also differentiate them very clearly from the Crinoids and Cystids. We have yet to become acquainted with any member of the two latter groups which has a subambulacral "lancet-plate" like that of the Blastoids. The five lancet-plates of a Pentremite are pierced by longitudinal canals which unite into a circumoral ring, and, as we believe, contained the ambulacral or water-vessels. So far as our present knowledge goes, this subambulacral structure does not occur in any other Pelmatozoa but the Blastoidea; and despite the number of apparently intermediate forms, we are strongly inclined to think that the three groups (Crinoids, Cystids, and Blastoids) are in reality much more distinct than has hitherto been supposed.

Messrs. Wachsmuth and Springer have changed their views upon several important points of Crinoid morphology since the publication of Part II. of their 'Revision.' Some of these changes have met, and probably always will meet, with the very general assent of their fellow-workers, such, for example, as the withdrawal of the designation "oral plates" from the calyx-interradials of *Cyathocrinus* and of the Blastoids. But in one case, perhaps the most important of all, we think that the change is decidedly for the worse.

Mr. Wachsmuth pointed out in the year 1877 that the interradial "proximal plates" which immediately surround the central plate in the vault of the Camarata correspond in many respects to the basal plates of the calyx. This view was further developed in Part II. (p. 15) of the 'Revision,' which appeared in 1881, and it has been pretty generally accepted in this country. In many species the proximals are surrounded by a ring of radially situated plates, which are universally recognized as representing the calyx-radials of the abactinal side. In the simpler forms of vault and in the young stages of the more complex types the central plate is thus enclosed by two alternating rings of plates, the proximal ones being interradial and the distal ones radial. The close correspondence between this arrangement and that of the apical system of a young Urchin or Starfish, and also the calyx of a stemless Crinoid like *Uintacrinus*, is so striking that Mr. Wachsmuth's suggestion seemed to throw a flood of light upon the composition of the summit in Crinoids, Blastoids, and Cystids alike.

Now, however, we are told by Messrs. Wachsmuth and Springer that the proximal dome-plates are the homologues not of the basals, but of the calyx-interradials of the abactinal side, and that the central plate against which they rest represents an undivided basal disk. But although no one knows better than themselves that the radials of almost every Crinoid rest directly on the basals, they make the following generalization on p. 53:—"In the summit the central plate occupies, in relation to the radials, the same position as the basals;" and again on p. 56, "Basals and radials, interradials and anal plates, are then found to occupy the same position orally as aborally."

We are sorry to find ourselves in such direct opposition to the American palæontologists; but we do not think they will contradict us when we say that there is not a single Crinoid in which the five (or six) calyx-interradials of the dorsal side occupy an intermediate position between the basals and radials. But unless this were so, not merely in isolated and very specialized genera *, *but in the majority of typical Crinoids*, both Palæozoic and Neozoic, the two statements which we have quoted and the new morphological views which they express cannot but be altogether at variance with the real facts of the case.

The position of the calyx-radials, not merely of the Pelmatozoa,

* Such as *Acrocrinus*, for example. Many very close parallels to the extremely anomalous forms of summit which occur in some of the Palæocrinoids may be found in the abactinal systems of Urchins, Starfishes, and Ophiurids.

but also of the Urchins and Stellerids, with regard to the abactinal centre is a very definite one; and if plates which typically occur inside the circle of dome-radials, between them and the actinal centre, are to be regarded as homologous with abactinal plates, which are generally outside, and only very rarely form part of the circle of calyx-radials *, the word "homology" would almost cease to have any meaning in Echinoderm morphology.

There is another view of the homologies of the proximals, which was suggested by the writer in 1879, viz. that they represent the oral plates of Neocrinoids. Messrs. Wachsmuth and Springer admit that these orals are the actinal representatives of the basals, as was pointed out by Götte; and they thus give additional support to the suggested homology between the orals of Neocrinoids and the proximals of Palæocrinoids, which last they formerly regarded as corresponding to the basals of the abactinal side. They bring several objections to this view, some of which are well founded; but it does not appear to us to involve anything like such serious inconsistencies as their own latest theory, which necessitates an homology between one set of plates outside the circle of abactinal radials and another set inside the circle of actinal radials!

Their objections will be fully discussed by the writer when he has finished the somewhat absorbing systematic work on which he is at present engaged. But two of them deserve notice here. In more than one place (pp. 36, 54, 58) the authors object to the theory which regards the proximals as homologous with the orals, because there are only five of the latter but six of the former plates, the posterior one being divided into two parts, usually by the anal system. This is a curious objection to come from those who tell us that these very six proximals are the actinal representatives of the five calyx-interradials of *Cyathocrinus* and the Blastoids. On the same principle they must deny the homology of the six interradials of *Elæacrinus* with the five which occur in other Blastoids; for the posterior one is divided into two parts by the anal plate. The same difficulty occurs with respect to *Glyptaster*, *Eucrinus*, *Dorycrinus*, &c., about which we are told, on p. 13 of Part II., that "the first true interradial in the posterior area is divided, and is represented by two smaller plates, separated by a special anal plate." But unless they deny the homology of the six interradials of *Glyptaster* and *Elæacrinus* with the five of *Cyathocrinus* their objection to a theory which homologizes "six proximals with five orals" loses all its force; and we do not think that they are prepared to go so far as this.

In every Neocrinoid the anus is outside the ring of oral plates, and this has always been felt to be one of the chief objections to the theory that the proximals are orals; for plates belonging to the anal system usually enter into the ring of proximals. But we may point out that the mouth-opening, which also serves as anus in Ophiurids and in many Asterids, is within the circle of orals, and that the anal system of a regular Urchin is situated within the ring of basals which are the admitted abactinal homologues of the orals; while the

* As in the Rhodocrinidæ and the recent *Thaumatocrinus*.

early forms of exocyclic Urchins have the anus placed in or near the calycinal system, from which it gradually recedes in those of later date. May not some change of this kind be traced in the relations of the anus to the actinal system of Palæocrinoids and Neocrinoids? In any case, however, this objection about the position of the anus comes rather oddly from critics who regard the undivided central plate of the actinal side in a Palæocrinoid as the "true homologue" of the quinquepartite oral pyramid of a Neocrinoid, and are also candid enough to describe on p. 50 how the anus of the Calyptocrinidæ is strictly central, "while the central piece is bisected, and the two halves, jointly with the proximals, form the sides of the anal tube."

The authors make the same objection to the view of Allman, Wyville Thomson, Dr. Carpenter, and most later writers that the ventral pyramid of *Haplocrinus* consists of five united oral plates; for they repeatedly state that one of these five large plates which they call interradials is pierced by the anal opening, and their figure on plate v. shows an exceedingly minute puncture at its central end.

We do not say that this is not an anal opening; but, considering the length of time that *Haplocrinus mespiliformis* has been known and the many writers who have figured and described it without noticing this point, we cannot but think that further evidence is necessary. Neither anal opening nor central piece are visible in Hall's figures of *Haplocrinus clio*, nor have we been able to find them in the British species of the genus.

The authors take the same view of the five plates covering the mouth of *Stephanocrinus* and *Allagecrinus* as they do in the case of *Haplocrinus*, regarding them not as orals but as calyx-interradials. But these plates appear to us in all three genera to be truly homologous with the orals of the Pentacrinoid larva. They cover the mouth and the origins of the ambulacra, just as the orals do in the young Neocrinoid, and this relation is not characteristic of the primary calyx-interradials in any other Crinoid. The converse of the above argument is employed by Messrs. Wachsmuth and Springer on p. 22 to disprove the "oral" nature of the interradials in *Cyathocrinus*. That these plates "are interradials, and not orals, is proved by the fact that they surround the peristome but do not cover it, and are succeeded by numerous other plates" (*i. e.* if they covered the peristome Wachsmuth and Springer would call them orals). But nevertheless the five plates which *do* cover the peristome in *Stephanocrinus*, *Allagecrinus*, and *Haplocrinus* are regarded by these authors as calyx-interradials.

It is only in the Cyathocrinidæ and in the Blastoids that the interradials have any close relation to the mouth at all; but they do not cover it in and shut it off completely from the exterior as the dome-plates of *Stephanocrinus* and *Allagecrinus* do, for they form the circumference of the peristome from which the ambulacra pass outwards over their apposed lateral edges. There is not a single Crinoid known in which plates that are universally recognized as calyx-interradials cover in the actinal centre. The very name "calyx-interradials" implies plates that are abactinal in their origin; while in Palæocrinoids, Blastoids, and Cystids alike we meet with types, such as *Allagecrinus*, *Stepha-*

nocrinus, and *Glyptosphærites*, in which the mouth is covered by a pyramid of five closely fitting plates as in Neocrinoids (*Hyocrinus*), Urchins (*Palæostoma*), and Holothurians (*Psolus*). There is therefore very strong evidence for regarding all these plates which have the same relations in five different classes of Echinoderms, and also occur in Asterids and Ophiurids, as mutually homologous, *i. e.* as oral plates. The very fact that actinal plates homologous with the basals of the abactinal side occur in every group of Echinoderms is sufficient to show their primary morphological importance; and it is not altogether in accordance with Wachsmuth and Springer's statement on p. 32, that "the phylogenetic evidence indicates clearly that the interradial element takes a most prominent part in the composition of the Palæocrinoidea;" and again, "Upon palæontological grounds we expect to find in the younger stages of the Palæocrinoid the oral system feebly, the interradial system extravagantly developed, while, according to Carpenter's interpretation of the plates, in the Palæocrinoid larva, the entire ventral surface from the radials up would be oral, *i. e.* actinal." This is precisely what we believe to be the case in larval forms like *Haplocrinus* and *Allagecrinus*.

The authors ask on p. 32 whether it is probable that these two genera "alone among all Palæocrinoidea should have no interradial plates?" To this we reply, "Certainly not;" for we know on the very best authority (*i. e.* their own) that interradials are "entirely absent" in some genera of the Ichthyocrinidæ; "while there are still other genera and certain species in which they are occasionally undeveloped dorsally." These remarks about the interradials occur on p. 19; and yet we are told, on p. 73, that "according to our interpretation they are present in all Palæocrinoids," and that they are "well-defined and permanent plates!"

On the same page is the following remarkable statement:—"Carpenter denies that interradials are present as a rule in Palæozic (!) Crinoids, and he therefore does not attach to these plates the value which we think they deserve." No authoritative reference is given for this assertion, and the writer has certainly never made an explicit denial of this kind. On the contrary, he has said that calyx-interradials are "very usually present," or present in "most" Palæocrinoids; though he is by no means prepared to admit that they occur in either *Haplocrinus* or *Allagecrinus*, as Wachsmuth and Springer assert.

He must further emphatically protest against the kind of argument which is employed by these authors to demonstrate the truth of their views respecting the summit of *Allagecrinus*. The following passage occurs in the description of this structure by Mr. R. Etheridge, Jun., and the writer, which appeared on p. 286 of the 'Annals' for April 1881:—"In none of these small specimens is there any trace of an anal opening, either directly piercing an oral plate or at the margin of the dome, between the orals and radials. *The central end of one or more of the former may be marked by faint tubercles* (figs. 5 & 7, pl. xvi.); but we cannot suggest any explanation of these."

On p. 33 Messrs. Wachsmuth and Springer put the words which

we have italicized in the following manner:—"It is very significant that Etheridge and Carpenter also found in *Allagecrinus* 'at the central end of one or more of the plates faint tubercles;'" and they then make use of their version to argue against the oral nature of these plates. "Whether these represent the tubercles which we discovered upon the surface of the interradials in *Cyathocrinus multiradiatus** (pl. iv. fig. 2), we are, of course, not prepared to assert with certainty, but it is worthy of note that Carpenter regards the latter 'as the conical openings in *Granatocrinus Norwordi*' (!), and it is very possible that they are the same thing in all three groups, which would prove better than anything else that the plates bearing them are not orals but interradials. The tubercles in *Allagecrinus* are evidently of structural value, but as there is but one figured, although the description speaks of one to each plate, and this is located laterally in one specimen and centrally in the other, all interpretations by us must necessarily be more or less problematical. We are inclined, however, to believe that the lateral one (fig. 5), in analogy with *Haplocrinus*, represents the anal opening, *i. e.* the larger tubercle in *Granatocrinus*, and the central one, if it exists at all, the central piece."

The whole point of this argument in the comparison of *Allagecrinus* with *Cyathocrinus Gilesi* and the tubercles upon each of its five interradials depends upon the supposed fact that "the description speaks of one to each plate." But all that the description says is that a faint tubercle *may be* present on *one or more* of the plates; and of the nine figures given of the summit only four show any trace of tubercles at all, and then of but one only, as Wachsmuth and Springer admit. Under these circumstances we should like to know why the tubercles are "evidently of structural value."

Furthermore, it was explicitly stated that there is no trace of an anal opening directly piercing an oral plate, as has since been described by Wachsmuth and Springer in *Haplocrinus*. A very large series of specimens was examined, and special attention was directed both to this point and to the possible presence of a central plate; but the result in both cases was a negative one. Wachsmuth and Springer tell us, however, on p. 53, that the central plate "is the only summit plate which is represented in every Palæocrinoid." This seems to us to be rather a bold assertion. There are many forms in which the summit is as yet unknown; while, though well defined in *Culicocrinus*, *Pisocrinus*, *Allagecrinus*, and two species of *Haplocrinus*, it has never yet been found to contain a central plate. The analogies of *Stephanocrinus* and *Elæacrinus* among the Blastoids, and of *Glyptosphærites* and *Caryocrinus* among the Cystids, show that the presence of a central actinal plate is not a constant character in either group. Why, then, should it be described as such in the Palæocrinoids, when there is at least as good evidence to the contrary as in the undisputed cases of *Stephanocrinus* and *Glyptosphærites*?

We cannot but admire the courage of Messrs. Wachsmuth and

* It appears from a reference to the explanation of pl. iv. fig. 2 that the specific name *multiradiatus* should read *Gilesi*. On the other hand, according to the explanation of fig. 6, *C. multiradiatus*, on p. 22, should read *C. multibrachiatus* as on p. 65.

Springer in thus rendering themselves liable to adverse criticism; and the same remark applies to various other morphological statements on their part.

They think that they have discovered a method of inferring the presence or absence of underbasals, more especially in those types which have the lower part of the calyx partially concealed. They give the following general rules, to which they "have not found a single exception among all Palæocrinoidea" (pp. 7, 8):—

"1. In species with underbasals, whenever the column is pentangular, its longitudinal angles are directed interradially, the sides and columnar cirrhi radially; on the contrary, in species with basals only, those angles are radial, the sides of the column and the cirrhi interradial.

"2. When there are underbasals and the column is pentapartite, the five sections of the column are radial, the longitudinal sutures interradial, the radiation along the axial canal radial; but the opposite is the case when basals only exist."

So far as we are aware, the first of these two rules always holds good among Palæocrinoidea; but there seems to us to be something seriously wrong about the statement of the second. It is illustrated by two figures on pl. vi.: fig. 15 is said to represent the "Basals of *Barycrinus*, with the joint of the quinquepartite column." No basals are shown in the figure, however, but only the underbasals (*u*) and the five sections of the first columnar joint (*c*). The arrangement of the figure is as follows:—the five sections of the stem are interradial, its longitudinal sutures radial, and the processes of the axial canal also radial. This (if correct) would suggest a *lapsus calami* in rule 2, the words *radial* and *interradial* having been transposed; and an examination of fig. 13 confirms this idea. It represents the basals of an undescribed monocyclic genus (*Stenocrinus*) with a quinquepartite column. The sections of the column are radial and the sutures interradial, whereas exactly the reverse ought to be the case according to rule 2. Apart from this unfortunate transposition, however, fig. 13 (if correct) shows that there is at least one exception to a part of rule 2, for the processes of the axial canal are *radial* both in fig. 13 and in fig. 15, whereas according to rule 2 they ought only to be so in the latter (*Barycrinus*).

This question is further complicated by the fact that in the "Diagram of *Barycrinus*," which appeared on pl. i. of the first part of the 'Revision,' the processes of the axial canal are *interradial*. Which of these two figures of *Barycrinus* is the correct one, the first or the second?

A precisely similar transposition to that just mentioned occurs in Part I. of the 'Revision' (p. 101). The sections of the column of *Barycrinus* are there said to be radial, while "the sutures are interradial, the opposite of *Heterocrinus*, in which they are radial." On p. 64, however, the ridges of the column of the latter genus are said to be radial, which would give the sutures an interradial position. The figure in Part III. of the "Basals of *Heterocrinus*, wiht a joint of the tripartite column" (pl. vi. fig. 14) is also rather puzzling, because neither sutures nor sections have either an inter-

radial or a radial position, and *Heterocrinus* has been described by Hall, Meek, and others as having a "pentapartite" column.

Having discovered what appear to be almost invariable rules for determining the presence or absence of underbasals in a Palæocrinoid, the authors turned their attention to the Neocrinoidea, with the following result (p. 8):—"Among Neocrinoidea our investigations could be extended only to comparatively few genera, as unfortunately these forms have either a round column or a circular canal. Only in a few species of *Pentacrinus*, *Millerocrinus**, and *Apiocrinus* did we succeed in making out one or the other of these points. In these genera, underbasals are said to be absent, but, curiously enough, the outer angles of the column are interradial, the cirrhi and radiation along the axial canal radial, exactly as in the column of Palæocrinoidea with underbasals, and, what is more remarkable, as in *Extracrinus*, in which, on the contrary, underbasals are said to be present. The latter seems to suggest that probably many Neocrinoidea either possess small underbasals or these were present in their larval form." On p. 71 it is positively asserted that Neocrinoids "are built upon the plan of dicyclic Crinoids. The angles of the column are directed interradially, the cirrhi radially."

Let us see how far these remarks are justified by facts. In the first place, there are no cirri at all upon the stem in two out of the three gerera which are mentioned by the authors on p. 8; and it would therefore have been better if they had said with respect to these three genera that the cirri are radial "when present."

A long series of plates illustrating the structure of these two genera (*Apiocrinus* and *Millericrinus*), which have no cirri on the stem, is given by Mons. de Loriol in the work on the French Jurassic Crinoids which we have noticed above; and as Messrs. Wachsmuth and Springer have copied two of the figures which it contains, we may fairly conclude that they have studied it with some care. We have examined it for the purpose of testing their statements, and have been surprised to find that in every species of *Apiocrinus* which has pentagonal uppermost stem-joints the angles are directed radially; and yet it is one of the three genera of which Wachsmuth and Springer state that "curiously enough the outer angles of the column are interradial," as in dicyclic Crinoids. In the case of *Millericrinus* the angles of the stem are radial in about half the species, just as in *Apiocrinus*; while they are interradial in the other half, which includes the two species in which underbasals are figured and described by de Loriol. This latter point therefore tells in favour of the authors' theory, as also does the fact that *Extracrinus* has underbasals and a column with interradial angles and radial cirri. But it is clear, on the other hand, that their very positive statement on p. 71 will need some considerable qualification before it can be applied to all the Neocrinoids.

The genus *Pentacrinus* presents difficulties of precisely the same kind. Although it has no underbasals the angles of its stem are

* This is generally spelt *Millericrinus* by students of the Neocrinoidea.

interradial and its cirri radial, and it is therefore "built upon the plan of dicyclic Crinoids;" but the processes of the axial canal are interradial, and not radial as they ought to be according to the generalizations on pages 7 and 8, which we have quoted above. The 'Challenger' Report upon the stalked Crinoids, which was in Mr. Wachsmuth's hands nearly four months before the presentation of his Part III. to the Philadelphia Academy, contains figures which illustrate this point in four recent species of *Pentacrinus*, and he would therefore have done well to make sure of his facts before generalizing on the subject. We doubt if there is a single species of *Pentacrinus* which has a radial axial canal. It is curious, however, that in the closely similar genus *Metacrinus* the processes of the axial canal *are* radial, though no underbasals are present as in *Extracrinus*. But perhaps the most curious anomaly is presented by the two allied genera *Bathycrinus* and *Rhizocrinus*. In the former, as in *Pentacrinus*, the angles of the top stem-joints are interradial, but so are the processes of the axial canal; while exactly the reverse is the case in *Rhizocrinus*, which, like *Apiocrinus*, has radial angles to its cirrus-less stem, though the processes of the axial canal are also directed radially.

All four genera agree, however, in the absence of underbasals, though one of the characters which should be correlated with their presence, together with one which should not, occurs in each type.

We cannot but wonder that with these facts before them Messrs. Wachsmuth and Springer should have committed themselves to the very positive statement that "the Neocrinoids are built upon the plan of dicyclic Crinoids."

There is another case of the same kind to which we must allude (p. 62). They have noticed "narrow grooves upon the inner surface of the vault, which meet beneath the median part of the oral plate, and follow the subtegminal galleries which enclose the ambulacral tubes;" and they have reasons for thinking that these grooves and the ridges which correspond to them on the internal casts "do not represent the ambulacral tubes." We will not discuss this point, but pass on to the conclusions which they draw on pages 62 and 137 (especially the latter)—"That the grooves are placed along the solid walls of the test, has led us to suppose that they were axial canals (!), and that perhaps in these Crinoids, contrary to others, and to the Neocrinoidea generally, the entire nervous system was located at the oral side, in conformity with other Echinoderms. Our interpretation becomes more plausible when we consider that in the Camarata the radials are never pierced by canals, and it would be difficult to understand how these ponderous arms could have moved without axial cords, unless their movements were altogether passive."

We wonder that the authors do not see that the same argument would hold good for the vault-plates, which are not perforate but merely grooved; and even supposing their statement about the Camarata to be invariably true, it does not imply, as they assume, that there were no nervous axial cords on the inner surface of the

grooved but imperforate radials. In the early Pentacrinoid larva the axial cords lie not within but on the ventral surface of the basals, radials, and brachials, "which are then mere flat plates; by an endogenous thickening of the calcareous network of those plates the axial cords come to lie in furrows channelled out in their ventral surfaces; while by a further endogenous growth of that network these ventral furrows are completed into canals, and it is by a still further endogenous thickening that these canals finally come to occupy the centre of each calcareous segment"*. This has been pointed out over and over again of late years, and it has been shown that each transitory condition of the Neocrinoid is a permanent one in certain Palæocrinoids. But according to the reasoning employed by Wachsmuth and Springer the early Pentacrinoid has no dorsal nervous system, because its radials are not "pierced by canals." Furthermore, the arm-joints of many, if not all, Camarata contain canals which all converge on the grooves of the radials. Were there no axial nerves within these canals? Apparently not; for it is suggested that "the entire nervous system was located at the oral side." If there were any real grounds for supposing this to have been the case, it would be necessary to remove the Camarata from the Crinoids altogether and to establish another class of Pelmatozoa for their reception. We believe that a much more satisfactory explanation may be given of these grooves upon the inner surface of the vault of the Actinocrinites than that suggested by the authors, who do not seem to have sufficiently considered the difficulties into which it would lead them; and we shall be much surprised if they do not withdraw it in the concluding section of the 'Revision.'

We may be permitted to express the hope that a little more care will be exercised in correcting it for the press than has been given to the one under review. References to wrong and even to nonexistent plates and the misspelling of specific names might have been avoided. There are three mistakes on p. 127 alone, while such errors as "Platynicridæ" and the statement on p. 41 that the anus of *Coccocrinus* and *Culicocrinus* "is located between the first and second radials" ought not to have escaped notice. Others of a similar kind have been already mentioned incidentally. The reader must also be cautioned against misunderstanding the authors' very free use of the word "evidently" when discussing controverted questions. It is employed as a short version of "in our opinion;" as, for example, in the passage respecting *Allagecrinus* on p. 33, which we have quoted above; the statement on p. 58 that the interradials of *Haplocrinus* "evidently separated in the growing animal and the oral plate moved outward;" and another on p. 55 that the underbasals of *Stemmatocrinus* are "evidently fused together to a single piece."

Space does not permit our noticing many other morphological points in which we altogether disagree with Messrs. Wachsmuth and Springer; and we cannot help thinking that in some cases, besides that of the underbasals, they have committed themselves to gene-

* W. B. Carpenter, Proc. Roy. Soc. 1876, p 454.

ralizations which will not bear investigation, and are premature, to say the least of it. But this does not prevent our expressing our full sense of the very high value of this, and also of both the preceding parts of their 'Revision of the Palæocrinoidea.' They have brought order out of chaos in a truly scientific manner, for which naturalists in general cannot be too grateful. The points on which we can venture to challenge their decision with respect to the value of species, genera, or families are indeed few and far between; and if we cannot say the same upon certain morphological questions, we must remember that although the authors began their Crinoid work merely as collectors, they have strenuously endeavoured, more than any other American writers on the Pelmatozoa, to interpret the structure of their fossils by the only method which can possibly give any value to their conclusions, viz. a knowledge of the morphology of recent Echinoderms. Their latest publication is illustrated by half a dozen plates, the last four of which are filled up by diagrams of various kinds; but the first two, which have been photographed from the drawings of Mr. Orestes St. John, are admirable expositions of actual structure as revealed by the choicest specimens at the disposal of the authors.

We shall look with very much interest for the publication of the concluding section of this most valuable work; and we should be only too well pleased to hear that it is but the precursor of a larger one to be issued as one of the finely illustrated monographs of the United States Geological Survey. We have heard a rumour as to the possibility of this, and every palæontologist will hope that it may prove to be a well-founded one. P. HERBERT CARPENTER.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

November 4, 1885.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communications were read:—

1. "On the Premaxillaries and Scalpriform Teeth of a large Extinct Wombat (*Phascolomys curvirostris*, Ow.)." By Sir Richard Owen, K.C.B., F.R.S., F.G.S.

The specimen described in this paper is a cast from a fossil discovered in a late exploration of the Wellington bone-caves, and sent to the author with some other casts from the same collection by the authorities of the Australian Museum, Sydney, New South Wales.

The fragments in question consist of the premaxillary bones, containing a pair of scalpriform incisors, 160 millim. ($6\frac{1}{2}$ inches) long, measured along the outer curve.

The teeth and the fragments of bone in which they are implanted were described in detail, and referred to the Wombat family. The

animal to which they belonged must have been somewhat larger than *Phascolomys medius*, Owen, but less than the type of the subgenus *Phascolomys*. The specific name is suggested by the chief characters that distinguish the present form from any hitherto known, recent or extinct.

2. "On the Structure and Classificatory Position of some Madreporaria from the Secondary Strata of England and South Wales." By Prof. P. Martin Duncan, M.B., F.R.S., F.G.S.

This paper consisted chiefly of a criticism of the conclusions arrived at by Mr. R. F. Tomes in various papers communicated to the Society.

All the species of the genus *Astrocœnia* which were described in the Supplement to the British Fossil Corals, Pal. Soc. 1867, from the Infra-Lias of South Wales, belong to that genus, and not to *Stylastræa*, de From. The drawing of *Astrocœnia plana*, Dunc., given by Mr. Tomes, does not correspond with the type specimen of the species. *Stylastræa sinemuriensis* and *S. Martini*, de From., do not form part of the fauna of the Infra-Lias of South Wales. *Cyathocœnia*, Dunc., is not the same as *Phyllocœnia*, Laube, which is *Koilocœnia*, Dunc. *Thecosmilia Martini* and *T. Michelini* of the European Hettangian are found in the Infra-Lias of England. *T. rugosa*, Laube, was first noticed in the Memoir of the Corals of the zone of *Ammonites angulatus*, Pal. Soc. 1867, and the species was properly figured. *Cladophyllia* is a subgenus of *Thecosmilia*. *Elysastræa*, Laube, has two well-marked species in the Sutton Stone. *Montlivaltia simplex* has the shape of the calice not merely dependent on pressure, but caused by normal growth. *M. Walliæ*, Dunc., has no evidence of "rejuvenescence," and the growth noticed is endothecal, and would be termed by Lindstrom "stereoplasm." *M. polymorpha*, Terquem et Piette, remains a member of the Infra-Lias fauna. *M. pedunculata*, Dunc., is not a *Cladophyllia*, but a simple coral of the genus to which it was assigned by the author. The geological position of the Sutton Stone and associated deposits is, from the palæontological evidence, above the Rhætic series.

The cast of a *Montlivaltia* figured by the author in the Memoir on the Corals of the Zone of *A. angulatus*, Pal. Soc. 1868, p. 68, does not coincide with *M. rhætica*, Tomes, but with *M. Haimei*. *M. foliacea*, Tomes, has not nine cycles of septa, as stated by its describer. The septal arrangement of *M. excavata*, Tomes, and *M. papyracea*, Tomes, is doubtful. *Thamnastræa* is not a perforate coral, but a Fungid. *Synastræa* and *Centrastræa* were not founded by M. de Fromentel; the former originated with Milne-Edwards, and the latter with d'Orbigny. *Centrastræa* is not synonymous with *Astræomorpha*. *Oroseris* is not a perforate coral; and Milne-Edwards and Jules Haime were quite correct in stating that the genus "se rapproche beaucoup des *Comoseris*;" and it is incorrect to state that one genus really bears but a faint resemblance to the

other. *Oroseris* is a subgenus of *Comoseris*, which is not one of the Perforata.

Microsolena, Lmx., is one of the Fungida.

Cyathophyllia, E. de From., is posterior in date to *Antillia*, Dunc., and therefore *C. oolitica*, Tomes, is *Antillia oolitica*, Tomes, sp.; but as *Antillia* is a subgenus of *Circophyllia*, Edw. & H., the name should be *Circophyllia oolitica*, Tomes, sp.

What is termed the "rejuvenescence" of corals by some zoophytologists has been long recognized as irregularity of growth, and there should be no difficulty in distinguishing worn growth-rings from calicular gemmation; but this has been confounded with the other condition. *Oppelismilia*, Dunc., is retained as a subgenus of *Montlivaltia*. *Axosmilia Wrighti*, Edw. & H., and *Montlivaltia Holli* (*Oppelismilia*, Dunc.) are not identical: they are both simple corals and differ from the fasciculate and compound genus *Donacosmilia*, E. de From. *Epismilia* is a worthless genus, because one can never be certain that the septa were not once spinose; moreover the presence and absence of spines and dentations on the free edges of the septa are not of physiological importance, and there is no distinction to be made between the soft parts of the recent corals with and without ragged septa. *Clausastræa consobrina*, Edw. & H., is not a species of *Confusastræa*. *Isastræa tenuistriata*, M'Coy, sp., confounded with some other form, but not by its author, is a true Isastrean. *Confusastræa tenuistriata*, Tomes, cannot remain in the genus, for it has characters which do not belong to it. *Chorisastræa*, de From., is not a good genus according to Milne-Edwards and Jules Haime, Reuss and Stoliczka; it makes a method of growth which is common to several fossil and recent genera of primary importance. *Thecosmilia gregaria* and *T. obtusa* are names which should be retained, and the forms should be removed from *Chorisastræa*. *Heterogyra*, Reuss, is a good genus. *Symphyllia Etheridgii*, Dunc., belongs to the genus with which it is associated, and not to *Phyllogyra*, Tomes. *Thecoseris* is an epithecate *Leptophyllia*, and *T. polymorpha*, Tomes, is quite distinct in its morphology from *Turbinoseris* and *Palæoseris*, Dunc. *Cryptocœnia*, d'Orb., is an imperfectly distinguished genus, and is replaced by *Cyathophora*, Edw. & H. Therefore *Cyathophora tuberosa*, Dunc., which has not a close resemblance to *C. Luciensis*, Edw. & H., and also *C. Pratti*, Edw. & H., remain as good species of their genus. The septal arrangement of what is termed *Cryptocœnia microphylla*, Tomes, is incorrectly given. *Montlivaltia caryophyllata*, Edw. & H., had not its septa wrongly described by its illustrious authors; Mr. Tomes says that they made an obvious mistake, and his own accusation proves that they were correct. The subject of fissiparity was not originally introduced by M. de Fromentel, but was well understood at the time when he wrote. The walls are not defective in corals increasing fissiparously. Fissiparity and gemmation were not confounded by Milne-Edwards and J. Haime or by the author. *Thecosmilia Slatteri*, Tomes, is a variety of *Cladophyllia Babeana*. The figure given by the author of *Thamnastræa Waltoni*, Edw. & H., has been misapprehended.

Isastræa oblonga, Edw. & H., was correctly described by those authors, and no addition to our knowledge of the form has been made. The genus *Isastræa* has its species budding within the calice and close to the outer wall, never, as stated, between the walls of calices. *Heliocœnia* is a subgenus of *Stylina*, and differs from *Placocœnia*, d'Orb. *Isastræa Conybearii*, Edw. & H., is a good species; it is not the same as *Clausastræa* = *Plerastræa Pratti*, Edw. & H. The type specimen of *Plerastræa Pratti*, Edw. & H., has a columella, and the authors of the genus did not describe it as having an essential columella. *Bathycœnia*, Tomes: nothing was stated in the work called 'A Revision of the Genera of Madreporaria' about the similarity of this genus and *Stylosmilia*; this is a statement difficult of explanation.

Every one of these numerous statements is made in opposition to the opinions of Mr. Tomes. Proper acknowledgment is made regarding the useful knowledge conveyed by Mr. Tomes about the localities of corals and the zones which some frequent.

The author of this communication agrees with Mr. Tomes on two points: Mr. Tomes has shown that, owing to the matrix of *Cyclolites Lycetti*, Dunc., not being sufficiently removed, the form is his *Dimorphastræa dubia*, and that properly the generic name should be *Dimorpharæa*. Again, Mr. Tomes has raised much doubt in the author's mind where a species placed by him under the genus *Lepidophyllia*, Dunc., should be placed; probably it will have to come within *Donacosmilia*, as stated by Mr. Tomes; but *Donacosmilia* requires careful working out.

3. "On the *Astrocœniæ* of the Sutton Stone of the Infra-Lias of South Wales." By Prof. P. Martin Duncan, M.B., F.R.S., F.G.S.

The species which were placed in the genus *Astrocœnia*, and which came from the Sutton Stone and Brocastle deposits of the Infra-Lias of South Wales, were reexamined in the instance of *A. gibbosa*, *A. insignis*, *A. parasitica*, and *A. plana* (Dunc.). These species were originally described by the author in his 'Monograph of the British Fossil Corals,' second series, Pal. Soc. 1867, pt. iv. no. 1, and were illustrated. A good specimen of *A. gibbosa* is described, and its structures are shown to be strictly Astrocœnian. The different states of the corallites produced by various conditions, such as growth and gemmation, were explained. The same course was taken with reference to *A. insignis* and *A. parasitica*, and the density of the united walls was shown to have nothing to do with any intermural structure or cœnenchyma in that sense.

A. plana was critically examined, and as it has all the characters of typical *Astrocœniæ*, it remains in that genus with the others.

November 18, 1885.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communications were read:—

1. "Results of Recent Researches in some Bone-caves in North Wales (Fynnon Beuno and Cae Gwyn)." By Henry Hicks, M.D.,

F.R.S., F.G.S. With Notes on the Animal Remains, by W. Davies, Esq., F.G.S., of the British Museum (Nat. History).

This paper contained the results of researches carried on in those caverns in the summers of 1883, 1884, and 1885 by Mr. E. Bouverie Luxmoore, of St. Asaph, and the author. The enormous collection of bones belonging to the now extinct animals of Pleistocene age obtained had been submitted for examination to Mr. W. Davies, and afterwards distributed to various museums. Several well-worked flint implements were also discovered in association with the bones.

The following are the conclusions arrived at by the author, from the facts obtained during the explorations:—That abundant evidence has been furnished to show that the caverns had been occupied by hyænas, and possibly by other beasts of prey, as dens, into which portions of carcasses of various animals had been conveyed in Pleistocene times. The very great abundance of some animals, such as the rhinoceros, horse, and reindeer, and the frequent presence of bones belonging to young animals, proved that the plain of the Vale of Clwyd, with that extending northward under the Irish Sea, must have formed a favourite feeding-ground even at that time. The flint implements and worked bones showed also that man was contemporary with these animals. The facts perhaps, however, of greatest importance, made out during these researches, are those which bear on some questions of physical geology in regard to this area, which hitherto have been shrouded more or less in doubt. The views on the physical conditions in Pleistocene times of the areas in North Wales in which these and the other bone-caverns occur, so ably put forward by Sir A. Ramsay, appeared to the author to be strongly supported by the results obtained in these explorations. The ravine in which the caverns occur must have been scooped out previous to the deposition in it of the glacial sands and Boulder-clays. This sand and clay, there seems good evidence to show, must have filled up the ravine to a height above the entrances to the caverns, and such sands and clays are now found at some points to completely fill up the caverns. How, then, did these sands and clays get into the caverns? Were they forced in through the entrances by marine action or by a glacier filling the valley? Or were they conveyed in subsequently to the deposition of the Boulder-clay in the valley and surrounding area? The position of the caverns in an escarpment of limestone, at the end of a ridge of these rocks, with a sharp fall on either side, prohibits the idea that the material could have been washed in from the higher ground, as has been suggested by some in the case of other caverns, if it had anything like its present configuration. Moreover, there is scarcely any deposit now visible upon the limestone ridge, and there is no certainty that there ever was deposited there any great thickness of such a clay as that now found in the caverns. The general position also of the bones in some of the tunnels seems to indicate clearly that the force which broke up the stalagmite floor, in some places 10–12 inches thick, and stalactites 6 to 8 inches across, which thrust many of the large and heavy

bones into fissures high up in the caverns and placed them at all angles in the deposit, must have acted from the entrance inwards, and the only force which seems to meet these conditions is marine action. The following seem to the author to be the changes indicated by the deposits. The lowest in the caverns, consisting almost entirely of local materials, must have been introduced by a river which flowed in the valley at a very much higher level than does the little stream at present. Gradually, as the valley was being excavated, and the caverns were above the reach of floods, hyænas and other beasts of prey occupied them, and conveyed the remains of other animals into them. Man also must have been present at some part of this period. Gradually the land became depressed, the animals disappeared, stalagmite was formed, and the sea at last entered the caverns, filling them up with sands and pebbles, and burying also the remains not washed out. Floating ice deposited in this sea the fragments of rocks derived from northern sources, and these became mixed with local rocks and clays brought down from surrounding areas. The greater part of the Boulder-clay in the Vale of Clwyd was probably deposited as the land was being raised out of this Mid-Glacial sea. During the process of elevation the caverns became again disturbed by marine action and the upper fine reddish loam and the laminated clays were deposited. It seemed to the author impossible to avoid the conclusion that these caverns must have been submerged, and afterwards elevated to their present height of about 400 feet above the level of the sea, since they were occupied by Palæolithic man and the Pleistocene animals.

2. "Description of the Cranium of a new Species of *Erinaceus* from the Upper Miocene of Œningen." By R. Lydekker, B.A., F.G.S.

The Author described the palatal half of the cranium of a large species of *Erinaceus* from the Upper Miocene of Œningen, which he regarded as closely allied to the existing *E. europæus*, and proposed to name *E. œningensis*.

3. "On the Occurrence of the Crocodilian Genus *Tomistoma* in the Miocene of the Maltese Islands." By R. Lydekker, Esq., B.A., F.G.S.

The Author described the anterior portion of the cranial rostrum of a Crocodilian from the Miocene of Malta, to which Prof. Sir R. Owen has given the MS. name of *Melitosaurus champsoides*. The author considered that there were no characters by which the specimen could be generically distinguished from *Tomistoma*. Mention was made of a second crocodilian skull from the Miocene of the Maltese Islands, and of a third from Lower Austria, both of which the author thought might be included in the same genus.

January 13, 1886.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communication was read:—

"On some Fish-remains from the Tertiary Strata of New Zealand." By James W. Davis, Esq., F.G.S.

A number of fossil fish-remains from Tertiary beds in New Zealand have been forwarded to the author by Captain F. W. Hutton, and were described in the present paper. The forms of which descriptions were given are two new species of *Lamna*, *Carcharodon angustidens*, Agassiz, and a new *Carcharodon*, one new species of *Notidanus*, one of *Myliobatis*, and one referred to *Sparnodus*. All the above are founded on teeth. A vertebra of *Lamna* and a fish-spine were also described, and the collection contained a specimen regarded by the author as a fragment of a Reptilian tooth.

MISCELLANEOUS.

On the Question of the Origin of the European Races of Dogs. By Prof. J. N. Woldrich.

I stand now in the same position as formerly* with regard to this question. It is, I think, just as impossible to derive our races of dogs from one or all of our wild European Canidæ (wolf, jackal, and fox) as it is to derive the European races of men from one or more of the still extant savage peoples, or to obtain a European civilized race by continued culture from a Bosjesman. Only a very careful detailed study of the fossil remains of Canidæ can lead us in this respect into the right road. I have therefore already, in my writings on Diluvial Canidæ, sharply separated the *forms* which occur, without any reference to the apparently scarcely solvable question whether they were species, races, or varieties. A fusion of allied fossil forms may be left to further study; this can only be effected when the detailed knowledge of fossil forms has become much more extensive.

According to my investigations, the following forms of domestic dogs have been made known from alluvial, prehistoric, and early historic times by the discovery of their remains:—*Canis familiaris Spalletti*, Strobel; *C. familiaris palustris*, Rutim.; *C. familiaris palustris ladogensis*, Anučin; *C. familiaris intermedius*, Wold.; *C. familiaris Mostranzewi*, Anučin; *C. familiaris optimæ matris*, Jeitteles (two forms); and *C. familiaris decumanus*, Nehring. Of

* See the author's memoir "Ueber Caniden des Diluviums," in Denkschr. k.-k. Akad. Wiss. in Wien, Band xxxix., and other papers.

Diluvial forms of *Canis* (Gray's true dogs) there are known :—*Canis hercynicus*, Wold.; *C. Mikii*, Wold.; *C. intermedius*, Wold.; and *C. ferus*, Bourgt. Figures and descriptions of these Diluvial dogs are contained in my publications.

I am now of opinion that *Canis familiaris Spalletti*, Strob., is to be regarded as the representative of the group of the living *spitz-dogs*, and that it may have originated from the Diluvial *Canis hercynicus*, Wold. *Canis familiaris palustris*, Rütim., is probably the representative of the existing *spaniels* and smaller sporting-dogs, as well as of a portion of the yard-dogs, and may be derivable from the Diluvial *Canis Mikii*. *Canis familiaris palustris*, or the peat-dog of the oldest pile-dwellings, was widely distributed over Europe as early as the Neolithic period; I have recognized it even in the Danish kitchen-middens; it appears to be one of the oldest of domestic dogs, as is evidenced by its wide distribution and its agreement (according to Studer) with the house-dog of the Papuas (*Canis hiberniæ*, Quoy et Gaimard). It would appear that the more powerful *Canis familiaris palustris ladogensis*, Anuč., also belongs to its series of forms. Now as domestic dogs similar to this dog of the stone age of Lake Ladoga are met with among the Lapps, Samojedes, Tschuktsches, and Tunguses, as also among the peoples of North America, the distribution of this form of dog would be remarkably wide. The peat-dog, however, had already varied considerably at the close of the stone age and during the bronze age, and this, it seems to me, less in consequence of select breeding than of intermixture; thus its smaller sharp-nosed forms in the later pile-dwellings may have already received blood of the spitz-dog and the larger ones blood of a larger dog, perhaps the widely-distributed *Canis familiaris intermedius*.

In *Canis familiaris intermedius*, Wold., we have the representative of our middle sized true sheepdogs (not the large wolf-like ones), and its ancestor is the Diluvial *Canis intermedius*, Wold. This prehistoric dog I have also recognized in the Danish kitchen-middens: it was widely distributed as early as the bronze age. Whether *Canis familiaris Mostranzewi*, Anuč., is also to be referred to the form of *C. familiaris intermedius*, or to the larger of the forms distinguished by Jeitteles, or whether it represents an independent form, I cannot at present decide. Of *Canis familiaris optimæ matris*, Jeitt., two forms are distinguishable—one greyhound-like, the other that of a large powerful hunting-dog. In France, as well as with us, there occur in the Diluvium the remains of a dog, *Canis ferus*, Bourgt., of the size of an average wolf, which will probably have to be united with the above-mentioned powerful hound-like form. Finally, as regards the prehistoric *Canis familiaris decumanus*, Nehring, this greatly resembles our *mastiffs*, of which I am inclined, with great probability, to regard the Diluvial *Lupus Suessi*, Wold., as the ancestor.

Lastly, that our *greyhounds* have their ancestor in a Diluvial ancestor of the African *Simenia simensis*, Gray, seems to me to be quite certain; and so also for some of our long-eared small dogs the

Diluvial ancestor of the African fennec (*Fennecus*, Gray) may come under consideration.

That our existing wild Canidæ (wolf, jackal, and fox) may in the lapse of time have been employed in crossing with true dogs, and thus might have contributed to the formation of race-forms (*e. g.* perhaps the sheepdog and wolfdog), I will not at present dispute; but the question whether and how far this may be the case, as well as the question how far still living forms referred to the groups of the wolf or the fox (such as *Lupus pallipes*, Gray, and *Lupus japonicus*, Nehring, and other wild Canidæ of Asia and Africa) approach or correspond with the remains of our Diluvial true dogs, and, further, the question whether and how far the forms of *Cuon*, Gray, occurring with us in the Diluvium, and which, by the peculiar texture of their teeth approach rather to the true dogs than to the wolves, may have taken part in the formation of the races of our domestic dogs, will have to be shown by further detailed investigations.

This, however, appears to me to be certain, that the ancestors of our European races of domestic dogs no longer exist (in Europe). At the same time I regard it as very probable that the so-called *feral* dogs of Syria are not "feral" domestic dogs at all, but the remnant of a Diluvial true wild dog, to be brought into union with *Canis familiaris palustris* and *ladogensis*. Whether this is the case also with the "feral" dogs of Africa I cannot at present assert.—*Anzeiger k.-k. Akad. Wiss. Wien*, January 21, 1886, pp. 12-16.

Pelagic Animals from Freshwater Basins in Alsace-Lorraine. By Dr. O. E. Imhof.

I took the opportunity of my presence at the fifty-eighth meeting of German naturalists and physicians at Strasburg to make an excursion on 23rd September last for the investigation of the microscopic fauna of the so-called "Weiher" between Saarburg and Dienze, in the north-west part of Alsace-Lorraine. There are here a number of larger and smaller accumulations of fresh water, which, with the exception of two, namely the Mittersheimer- and Gunderchingen-Weiher (both the property of the State), are periodically for some years laid dry and cultivated over almost their whole extent. The largest of them may be the Linden-Weiher, near Dienze, the bottom of which is at present under cultivation. Some of these reservoirs of water are of considerable extent; thus the above-mentioned Mittersheimer-Weiher measures about 4½ kilometres in length.

On the 23rd September, by means of the pelagic net, I collected material in three of these pools, namely the Mittersheimer-, Niederstein-, and Zemmingen-Weiher. In the last I had a boat at my command, while in the former two freshwater basins I attained my object by throwing out the net from the sluice, where in general the deepest part occurs.

The Protozoa, Rotatoria, and Entomostraca found in these basins are as follows:—

I. Mittersheimer-Weiher (229 metres above sea-level).

Protozoa: *Dinobryon divergens*, Imh.
Peridinium, sp.
Ceratium hirundinella, O. F. Muller*.
Codonella, sp.†

Rotatoria: *Synchæta pectinata*, Ehr.
Polyarthra platyptera, Ehr.
Anuræa cochlearis, Gosse.
— *longispina*, Kellicott.
—— *aculeata*, Ehr., var. *regalis*, Imh.

Cladocera: *Daphnella brachyura*, Liévin.
Daphnia kahlbergensis, Schodler.
Bosmina, sp.
Leptodora hyalina, Lilljeb.

Copepoda: *Cyclops*, sp.
Diaptomus, sp.

II. Niederstein-Weiher (1 kilometre long, 231 metres above sea-level).

Protozoa: *Volvox minor*, Stein.

Rotatoria: *Triarthra longiseta*, Ehr.
Anuræa cochlearis, Gosse.
—— *aculeata*, Ehr., var. *regalis*, Imh.
Asplanchna, sp.

Cladocera: *Daphnella brachyura*, Lievin.
Daphnia, sp., ♂ and ♀.

Copepoda: *Diaptomus*, sp.

Insecta: *Corethra*-larvæ.

III. Zommingen-Weiher (1·7 kilometre long, 215 metres above sea-level).

Protozoa: *Volvox minor*, Stein.
Codonella, sp.

Rotatoria: *Synchæta pectinata*, Ehr.
Triarthra longiseta, Ehr.
Polyarthra platyptera, Ehr.
Anuræa cochlearis, Gosse.
—— *aculeata*, Ehr., var. *regalis*, Imh.
Pterodina patina, Ehr.
Brachionus Bakeri, Ehr.

* For the present I cite under this name all the *Ceratia* nearly approaching Muller's form, of which it may be thought that they are mere varieties.

† *C. lacustris*, Entz. (Zur naheren Kenntniss der Tintinnoden, 1885).

Cladocera : *Daphnella brachyura*, Liévin.
Daphnia mucronata, O. F. Mull.
——, sp.

Copepoda : *Cyclops*, sp.
Diaptomus, sp.

Besides the above-named seven species of Rotatoria the examination of the material from this last basin furnished two other species, which, however, I am unable to identify with known forms. One of them is a *Brachionus* which stands between *Bakeri* and *polyacanthus*, Ehr. On the anterior dorsal margin the carapace bears four spines, as in *polyacanthus*; but of these the two intermediate ones spring from a broad base, narrow rapidly into a long uniformly thin process, and are separated from each other by a deep and broad emargination, at least as far as from the shorter lateral spines, which are little more than half their length. On the ventral surface we find no teeth at this part, but in the middle there is a small notch. The place of issue of the foot is furnished with two laterally-placed, pointed, jagged teeth. The general form of the body as compared with the two above-mentioned species is more elongated and only a very little inflated at the sides. Length of the body without the spines 0·336 millim.; greatest breadth 0·240 millim. This species may be denominated *Brachionus lotharingius*.

The body of the second species has a cylindrical form, straightly truncated in front, without processes posteriorly, from the termination of the second third (after a previous slight inflation) running out to a point, and passing into two spines of unequal development which originate close together. The right spine is considerably stouter and also rather longer than the left one, which, however, attains the length of the body. At the anterior extremity of the body dorsally two long thin spines, directed backwards at the sides of the body, are attached. Their basal parts are in contact in the middle line of the back. In these also we find an unequal development, inasmuch as, of these appendages, the right one is longer than the left and at the same time rather stouter. In the preserved specimens I could not with certainty recognize any special musculature for moving this stalkless fork; but it may function as a locomotive apparatus, as I have met with it in different individuals standing off at different distances from the body, from which we may conclude that it has a certain mobility. This organization would approximate the present wheel-animalcule to the genera *Triarthra* and *Polyarthra*; but I must leave it to a fresh examination of living specimens to decide its reference to any genus. In the definition of the species the unsymmetrical development of the spines may be of value.—*Zoologischer Anzeiger*, No. 211, December 14, 1885, pp. 720–723.

Worms in Ice.

Prof. Leidy referred to a former communication on the occurrence of organisms in ice (see Proc. Ac. Nat. Sci. Phil. 1884, p. 260), and stated that Dr. S. C. Thornton, of Moorestown, N. J., a couple of weeks since had submitted to him for examination a bottle of water from melted ice, such as was habitually used in his family, and in which he said he had observed living worms. A number of these proved to be present in the specimen, but were all dead. Having expressed a desire to confirm the statement that the worms were observed alive in the fresh ice-water, Dr. Thornton last week had obligingly sent him a basket of the ice. This was part of the provision made nearly a year ago from the vicinity of Moorestown. The ice was full of air-bubbles and water-drops. On being melted a number of the worms were liberated, and proved to be in a living and quite active condition. It is probable that while imprisoned in the ice they may not have been frozen, but perhaps remained alive in a torpid condition in water-drops. It is a remarkable fact that these animals should remain so long alive in the ice and yet die so readily in the melted water subsequently. The worms are of the same species noticed in the ice-water of the first communication, and which was derived from similar ice procured from a mill-pond in Delaware Co., Pa. These facts would indicate that it is desirable to avoid the spongy ice from stagnant waters, as being liable to retain organisms which would be detrimental to us. In the clear ice, such as is served in Philadelphia, no living organisms are detected. The little worms of the ice appear to be an undescribed species, and may therefore be characterized as follows:—

Lumbricus glacialis.

Worm from 4 to 6 lines long, translucent white, cylindrical, anteriorly acute, tapering most behind and obtuse, of from 35 to 50 segments; oral segment with a blunt conical upper lip, unarmed and eyeless; succeeding segments with four rows of podal spines, in fascicles of three; spines pointed at the free end and hooked at the attached end, nearly straight or slightly sigmoid; generative organs occupying the interval of the third and seventh spine-bearing segments.

Thickness of worm 0·15 to 0·25 millim.; podal spines 0·3 to 0·375 millim. long.—*Proc. Acad. Nat. Sci. Philad.* 1885, p. 408.

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XXVIII.—*On Dr. Bertkau's Classification of the Order Araneæ, or Spiders.* By Prof. T. THORELL.

It is a well-known fact that a natural classification of the Spiders—which form the best studied, the most numerous, and perhaps the most interesting Order of the Class Arachnida—is a problem, the solution of which offers very great difficulties, and that a generally adopted system of classification of these animals is therefore still a desideratum. Most of the older arachnologists, such as Lister, Clerck, De Geer, and, at first, even Latreille*, based the distribution of the Spiders into higher groups, not on differences in their *organization*, but on certain peculiarities in their *habits*, especially on their mode of locomotion and the form of their webs. Against this principle of classification the objection may be reasonably made that it is rather unscientific, not being founded on characteristics taken from the animals themselves; it has nevertheless been maintained by some more recent authors as the basis of their classifications. It may at first sight appear difficult to understand the reason of thus adhering to a principle which in other departments of zoology is generally and justly abandoned, if ever made use of; but I think it may easily be explained by the fact that the differences in the form of the web and the mode of locomotion which the Spiders exhibit correspond, *upon the whole*, with a peculiar "habitus" and with modifications

* In Cuvier, 'Le Règne Animal, distribué d'après son Organisation,' iii. (1817).

in the animals' structure, which, it is true, may sometimes be difficult sharply to define, but which, in general, make it easy to decide to which of the divisions, based on these differences, a spider belongs, even when nothing is known of its habits.

Concurrently with some classifications in which Spiders were grouped in two or more great divisions, according to differences in their inner (Dufour) or outer (Walckenaer, Blackwall, &c.) *structure*, several attempts were also made, at a rather early period, to combine the two principles in question, the *structural* and the *biological*, the principal stress being laid on the *organization*, especially on the modifications of the *external* parts, the characters taken from the animals' habits and webs being considered less important or auxiliary. Thus the old well-known biological groups were, in general, maintained, often even with the old denominations given to them by Latreille—Orbitelæ, Inæquitelæ, &c. An important step in this direction was made by Sundevall, who, in his "Svenska Spindlarnes Beskrifning"* (Description of the Swedish Spiders), gave a rather detailed exposition of the characteristics, taken from the external parts, which he considered to distinguish each of the seven "tribus" (Orbitelæ, &c.) into which, with Latreille, he divided the Spiders†; the form of the web &c., he mentioned first at the end of the diagnoses of the different "tribus." In his 'Conspectus Arachnidum' (1833) Sundevall retained, it is true, the same great groups, but he called them "families," and changed their names into *Epeirides*, *Theridides*, *Drassides*, &c.; and thus escaped the accusation of having regarded the form of the webs and the mode of locomotion, implied in the Latreillian names, as the distinguishing characters of the groups adopted. He was followed by Westring, who, in his admirable work 'Araneæ Suecicæ,' characterized his "families" Epeiridæ, Therididæ, &c. still more sharply and more in detail than Sundevall had done. As, however, Sundevall and Westring were but insufficiently acquainted with extra-European spiders (Westring took into consideration only those found in Sweden), the characters of the groups adopted by these authors do not always hold good for the exotic forms, and are in many respects in need of enlargement and other modifications; but the method of characterization followed by them, and especially by Westring, is no doubt still the right one, *i. e.* to give a *detailed* exposition of (*at least*) the external parts in each group,

* K. Vetenskaps-Akademiens Handlingar för år 1829, pp. 199–203 (1830).

† The Territelæ of Latreille he called, however, "*Theraphosæ* (Walck.)."

noticing the *exceptions* from every character thus given, so far as they are known; adding to this exposition such remarks on the habits &c. of the animals as may be of use in their determination or are of more general interest.

In a work treating of the synonyms of a certain number of European Spiders*, in which some definition of the genera adopted was necessary, and where it also seemed desirable to have their systematic connection indicated, I have myself adopted, in the main, the classification of the aforesaid authors; but as it had become necessary, from the progress of arachnology in general, and especially from the great number of new genera and species discovered in later years, to resolve the seven great "families" or "tribus" into a number of smaller groups (already at that time in part called "families"), I readopted for those greater groups, each divided into a certain number of families, the old Latreillian denominations, only with a few slight modifications (Orbitelariæ, Retitelariæ, Tubitelariæ, &c.), and raised them to the dignity of *Suborders*† —a term instead of which I shall here use that of *Tribus*. I further endeavoured to characterize the different suborders or tribus as far as was necessary for the classification of the *European* genera; as to the *exotic* families and genera, I also tried to determine to which of the tribus adopted by me they probably belonged, without, however, concealing from myself that "a by no means inconsiderable number of forms could not without great uncertainty, even if at all, be included under the hitherto received families and higher groups"‡, and that probably one or more new tribus would in the course of time be proposed §, for instance by dismemberment of the

* Thorell, "On European Spiders," I. (in Nova Acta Reg. Soc. Sci. Upsal. ser. 3, vol. vii. fasc. i. et ii., 1869 and 1870); [II.] 'Remarks on Synonyms of European Spiders' (1870–1873).

† Some years later (see Thorell, "Description of the Araneæ collected in Colorado in 1875 by A. S. Packard, jun., M.D.," in Bulletin of the U.S. Geological and Geographical Survey, vol. iii. no. 2, p. 477, 1877) I changed this word into the less significant term "Sections," it having been justly remarked (by Gerstacker) that the differences between the groups in question were not of sufficient weight to warrant for them the name Suborder. The term "Tribus" used by Latreille has, however, the priority, and is also preferable, in so far as it implies that the groups are *natural*, or formed of closely allied families and genera.

‡ Rem. on Syn. p. 596.

§ In 'Die Arachniden Australiens,' p. 231, L. Koch has formed the Tribus (Suborder) *Ruditelariæ* for the genera *Celænia* or *Thlaosoma* and *Cryptothele*; I think, however, that these genera may be included under the Orbitelariæ (see Rem. on Syn. p. 599). More recently Dahl has formed the Tribus (Suborder) *Plagitelariæ* for *Pholcus*, characterized by having only two air-sacs and no tubular tracheæ (see F. Dahl, "Analytische Bearbeitung der Spinnen Norddeutschlands, mit einer anatomisch-

great and polymorphous tribus Tubitelariæ. But in spite of these and other shortcomings, the classification of the Spiders given in my work 'On European Spiders' has, with or without some slight modifications, been adopted by most living arachnologists.

Very different from this classification, in which the primary groups of the Spiders are distinguished chiefly by means of characters taken from the *totality* of their *external* parts, and little notice is taken of their internal or anatomical structure, is a system of classification lately proposed by Dr. Philipp Bertkau* of Bonn; for not only are the principal groups in this system based on features which are more isolated and by most other authors considered to be of comparatively less importance, but he also gives much attention to the internal parts, and especially to the differences in the structure of the *breathing-organs*, thus approximating to the classification adopted by Dufour. But while Dufour† and, at last, following him, Latreille‡ divided the Spiders into "*Quadripulmonaires*" and "*Bipulmonaires*" (*Tetrapneumones*, Latr., and *Dipneumones*, Latr.), on the ground of the different number, four or two, of their *air-sacs* or so-called lungs (lung-sacs, lung-books, lamellar tracheæ), they are by Bertkau divided into the two suborders *Tetrasticta* and *Tristicta*, the former with *four*, the latter with *three breathing-holes* (spiracles, stigmata). The Tristicta are further divided into two groups, *Cribellata* and *Meromammillata*, of which the former are provided with the spinning-organs known under the names of *cribellum* (or inframammillary organ) and *calamistrum*, the latter being devoid of these organs; the Meromammillata Bertkau divides into *Perissonycha*, with *three*, and *Artionycha* with *two* tarsal claws. All these different groups are divided into a certain number of "families," in the characterization of which the structure of the organs of respiration and generation plays in general an important part. To the *biological*

biologischen Einleitung," in Schriften des naturwissenschaftlichen Vereins für Schleswig-Holstein, vol. i. 1883).—On the systematic position of *Pholcus* (and *Ctenium*), see further on.

* See especially his "Versuch einer natürlichen Anordnung der Spinnen," in Archiv für Naturgeschichte, xliv. i. pp. 351 *et seq.* (1878), and his treatise "Ueber das Cribellum und Calamistrum. Ein Beitrag zur Histiologie, Biologie und Systematik der Spinnen," *ibid.* xlviii. i. pp. 316 *et seq.* (1882).

† "Observations sur quelques Arachnides quadripulmonaires," in Annales générales des Sciences Physiques, vol. v. p. 26 (1820). It is known that Dufour, believing that *Dysdera* had four air-sacs, erroneously referred that genus to his "Araignées quadripulmonaires."

‡ In his 'Familles Naturelles du Règne Animal, &c.,' 1825.

characteristics a systematic value is, on the contrary, but rarely attributed.

If I undertake here to offer some critical remarks on Dr. Bertkau's now-mentioned views, I do so with great hesitation, and because I have in vain waited for some person more competent than myself, or at least more versed in the anatomy of the Spiders, to undertake a review of Dr. Bertkau's works on the classification of this group of animals. These works (of which the most important, 'Versuch einer natürlichen Anordnung der Spinnen'*, was published nearly eight years ago) are indeed worthy of the greatest attention, not only of every arachnologist, but of zoologists in general; for besides being of great interest from a classificatory point of view, they are rich in new and important observations on the life-history and the anatomy of the animals on which they treat. Dr. Bertkau is, as is generally known, a most sagacious and learned entomologist; he has, more especially in the field of arachnology, enriched his science not only with good works of a systematic, descriptive, and zoogeographical character, but also with many anatomical and biological discoveries of great importance; it is, for instance, to Dr. Bertkau that we are indebted for our knowlege of the principal parts of the male organs of copulation in Spiders, and of the functions of these parts, of which we had formerly only imperfect and erroneous notions.

Before entering on the examination of Dr. Bertkau's spider-system I ought perhaps to try to give an answer to the criticisms which he has directed against the method now-a-days most generally adopted of classifying the animals in question, and especially against the classification adopted in my work 'On European Spiders.' That this classification should, in many points, be modified and improved, and that some of Dr. Bertkau's criticisms are fully justified, I am, however, the first to acknowledge.

The considerable progress which arachnology has made during the last quarter of a century must of course have exercised a modifying influence on the attempts at a natural classification of the animals before us; but it cannot well be said that this progress has made the solution of the problem more easy than it formerly was. The difficulties which here present themselves depend, as Bertkau (*A*, p. 352) justly remarks, chiefly on the body of the spiders being (compared with that of insects and crustaceans, for instance) but little differentiated, or

* In the following pages, when citing this 'Versuch' and the treatise 'Ueber das Cribellum und Calamistrum' (see above, p. 304, footnote), I shall, for the sake of brevity, call the former work *A* and the latter *B*.

formed of but a small number of parts (segments, extremities, &c.), which parts, again, show only slight variations in the different spiders; from this it follows that the entire group is, upon the whole, of a highly uniform aspect, exhibiting but few important structural points on which to rely for a natural classification.

Other difficulties arise from the fact that most of the characters generally found to be constant, and therefore of importance in the classification of these animals, *may* yet vary most materially in one and the same group. The *tarsal claws*, for instance, the number of which (three or two) gives such good and reliable characters for many tribus and families, may, however, within the same family, be sometimes two, sometimes three; in a few genera (*Palpimanus*, *Dasumia*) some of the legs have, in the same animal, three, and the other legs only two tarsal claws. The distribution and the number of the *eyes*, which also often give sure characters both for tribus and families, may nevertheless be very different within the same family or even the same genus (*Nesticus*, *Hadites*). It might have been expected that, just as the presence and peculiar structure of the *spinning-apparatus* is perhaps the most salient and most characteristic feature throughout the whole Order of Spiders, so the number and the shape of the *spinners* ought to offer reliable characteristics for the different higher and lower groups within the Order; but even this is far from being the case, as I shall have occasion to remark further on.

Add to this that the two sexes of one and the same species often differ from one another in the most important points, and that the young specimens are often very unlike the adults, and it must be admitted that it is not an easy task to draw up a natural classification of this order of animals.

If (passing by, for the moment, the more special criticisms in Dr. Bertkau's works, viz. those which relate to the families and genera, and which we shall take into consideration as suitable opportunities occur) we fix our attention on his objections to dividing the Spiders into the seven tribus Orbitelariæ, Retitelariæ, Tubitelariæ, Territelariæ, Laterigradæ, Citigradæ, and Saltigradæ, these objections may perhaps be summarized as follows:—

1. A higher group, suborder or tribus, is natural only on the condition that all the families and genera included in it are more closely related to each other than to any genus or family of another suborder or tribus (*B*, p. 345). But in the system of classification in question there are genera which, though belonging to one and the same family, differ more

from each other than from genera belonging to another family, nay, even another tribus (*A*, p. 353); and the aforesaid condition is only fulfilled, among the seven tribus, by the Territelariæ, and approximately also by the Laterigradæ and the Citigradæ. The Orbitelariæ contain, as an alien element, the Uloborinæ; the Retitelariæ the genus *Pachygnatha*; the Saltigradæ the family Eresoidæ; the Tubitelariæ are composed of the highly heterogeneous families Agalenoidæ, Filistatoidæ, Dysderoidæ, and Drassoidæ (*B*, pp. 335 and 336), and form a receptacle into which all those forms have been thrown that could not find a place in the other tribus (*B*, p. 345).

2. Of a natural system of classification it may be required that the groups regarded as coordinate ("gleichwerthig") should really have the same systematic value; but this is not the case with the aforesaid tribus: the Territelariæ, for instance, correspond in value to all the other tribus taken together (*B*, pp. 86 and 87).

3. The characters employed to distinguish the different tribus are partly (for instance, Orbitelariæ and Retitelariæ) of a very subordinate nature, and even then liable to exceptions, partly not indicated at all or not given with sufficient sharpness (*B*, p. 334). The insufficiency of the hitherto received classification shows itself in the vacillating opinions as to the family in which various genera ought to be placed (*A*, p. 353).

4. The denominations Orbitelariæ, Retitelariæ, &c. are not systematic categories, but only names that indicate a biological peculiarity (*B*, p. 336).

Briefly, then, the tribus adopted by me are (1st) neither natural, (2nd) nor of the same value, (3rd) nor distinguished by sufficiently important or distinctly expressed characters; and, 4th, their names are inappropriate.

In so far as these criticisms are directed against the classification adopted in my work 'On European Spiders,' it should first of all be borne in mind that it was not my intention in that work to give a complete characterization of the different tribus, but only to adduce, concerning those groups, as much as appeared to be, at that period, necessary and sufficient for the referring of a given family or genus to the tribus to which it was believed to belong; it should further be observed that in that work the principal stress was laid on the *European* forms, the disentanglement of the synonyms of which was its chief object. It was supposed that the characters which had been given of the groups in question by other authors, and especially by Westring, were known to the

readers of the work, and consequently that they would not find it difficult to refer an unknown spider (at least a European one) to its respective tribus. Only the most prominent and interesting forms of *exotic* spiders then known were mentioned, and an attempt was made to assign to the exclusively exotic families a place in the different tribus, so far as my restricted knowledge of the matter permitted me to do. And when I believed I had determined, in a way sufficient for my purpose, the limits of the six higher tribus, I could, when coming to the lowest, the Tubitelariæ, which also is the most polymorphous and therefore most difficult to characterize in few words, restrict myself to a *negative* characteristic, viz. that of saying that all the spiders then known "which could not be classed under another tribus" belonged to the Tubitelariæ*. In order to distinguish the Orbitelariæ from the Retitelariæ, only one character of the many given, for instance, by Westring, was, it is true, adduced by me—that, namely, which is taken from the height of the clypeus compared with that of the area formed by the four central eyes, a character which has its exceptions (duly indicated) quite as well as all the other marks adduced by Westring, including even that given by Bertkau as distinguishing his Epeiridæ from his Theridiidæ, viz. the presence in the mandibles of the former group of a so-called basal spot ("Basalfleck"). That there should exist an isolated characteristic always and without exceptions sufficient for the limitation of all the different tribus, I do not believe, and never have believed.

1. That *some* of the tribus, as they have been understood in my above-named work, contain elements that ought to be removed from them, I hasten to admit; and it is in the first place Dr. Bertkau's merit to have assigned to those alien elements a better place in the system. Thus I unhesitatingly admit that the Eresoidæ do not belong to the Saltigradæ, and that they probably have their true place in the vicinity of Bertkau's Amaurobiadæ, and therefore in the tribus Tubitelariæ (the Palpimanoidæ should probably also be classed under this tribus). I also agree with Dr. Bertkau that *Pachygnatha* ought to be detached from the Retitelariæ and united with the Tetragnathoidæ†, within the tribus Orbitelariæ. Both the Retitelariæ and the Saltigradæ may, I think, after this elimination, be considered entirely natural groups, at least as regards European forms. That not only the Territelariæ, but also the Laterigradæ and the Citigradæ

* 'On European Spiders,' p. 109.

† On this family see further on.

are good systematic units, even Dr. Bertkau himself would seem to admit. There remain then to be discussed the Tubitelariæ and the Orbitelariæ. As to the former of these tribus, Dr. Bertkau enunciates nearly the same opinion about its nucleus, the family Drassoidæ, as I had expressed about the tribus Tubitelariæ in general, viz. that in their habitus and in their way of life the members of this family show a certain polymorphism and manifold points of contact ("Anklänge") with other families (*A*, p. 375; conf. Thor., On Europ. Spid. pp. 41 and 109). Just as the family Drassoidæ is a natural group notwithstanding its being looser and more polymorphous than most, if not all, other spider families, so the *tribus* to which the Drassoidæ belong, and which is, as it were, an enlargement or amplification of that family, is, I think, a natural group, although it be less compact and more polymorphous than the other tribus. As to the Agalenoidæ, they are so nearly related with the Drassoidæ, and show such gradual transitions to this latter family, that arachnologists have, in general, had recourse to the character (in this case quite artificial) afforded by the different number of the tarsal claws, in order to be able to distinguish these two families; so that genera (*Agrœca*, for instance) which in all other respects closely agree with the Agalenoidæ have, on the strength of that character, been removed from this family and placed among the Drassoidæ. That the Dysderoidæ (of which we shall speak more in detail further on) differ from the other Tubitelariæ in a few important points and show some affinity with the Territelariæ is true; but they are, at all events, much more closely related to the typical Tubitelariæ than to any other spiders. If the Tubitelariæ should be resolved into two or more tribus, then the Dysderoidæ might, of course, be made to form a particular tribus, as might perhaps also be the case with the Filistatoidæ; I for my part prefer, however, for the present not to increase the number of the tribus generally admitted, and think it is better to add the two above-named (and other) more or less aberrant families to those tribus within which they have their nearest allies. It is indeed quite easy to dismember and divide the different groups, tribus, families, and genera almost *ad infinitum*; but it is more difficult and, I think, more meritorious to try to unite them into higher units, and thus to form of all these apparently "disjecta membra" an organic whole—a *system*.

2. With regard to the objection made by Dr. Bertkau under this head (2), it would indeed *appear* as if the claim to a natural classification, which he sets forth, were quite reasonable; but in reality it is not so. It is not the zoologist or

botanist who creates the natural groups of animals or plants, for these groups already exist in nature, sometimes sharply distinguished from each other, sometimes more or less closely united by means of transition-forms. The naturalist must take them as they are, learn to know them and to characterize them—that is all. Now it is not often the case, in *nature*, that two or more (in our classifications, coordinated) groups really are of precisely the same systematic value; and on this circumstance depend the often so greatly varying opinions as to whether a given group shall be considered coordinate with or subordinate to another. The case is the same with most zoological higher groups, as, for instance, with the zoogeographical "Regions" into which the surface of our globe is divided: one region is of greater value, in a zoogeographical respect, than the rest, and is therefore by some authors divided into *two* regions; another region is of less value than the others, and is therefore sometimes considered a mere *Sub*region, or part of another Region; and as we cannot change the distribution of land, water, &c. on the earth, there is no help for this. We need not go far to find similar examples in zoology. The class Arachnida is, I believe, in general (if we do not include the Pantopoda or Pycnogonoidæ in this class) divided into the following orders:—Araneæ, Pedipalpi, Scorpiones, Opiliones, Chelonethi (Pseudoscorpiones), Solifugæ, Acari, Acanthotheca, and Cormopoda (Tardigradæ). Now these groups ought, it would seem, to be of the same systematic value; but this is far from being the case; some of them may, in fact, with almost equal reason be regarded as subordinate to or as coordinate with another. Thus we see that the Pedipalpi and the Scorpiones are by some arachnologists united into a single order, of which they form two *sub*orders; Pedipalpi, Scorpiones, Opiliones, Chelonethi, and Solifugæ are often *all* considered to form together a single order, that of the Arthrogastra. The Acari are sometimes considered to be a *subclass* (as I, for my part, think that the Cormopoda should be considered) of the same value as all the foregoing orders taken together—and so on. And it is quite impossible to change this state of things by assigning to the groups in question new limits, so as to form them into really coordinate groups, for they are all so well defined in nature, so "natural," that nobody can think of altering their compass. In fact, "The works of Nature refuse to be crammed up into the pigeon-holes systematists would like to get them all into."

I therefore think it of little use to enter upon a minute examination, from this point of view, of the tribus into which

Spiders are in general divided. I think these tribus are *approximately* of the same systematic value, and this, if true, is quite sufficient. An exception may, however, be made for the Territelariæ, which really differ from the other tribus by characters of much greater importance than those which distinguish the other tribus from each other; they form a group that may, with almost equal reason, be regarded as coordinate with *all* the other tribus taken together, as with each of them. However, since Holmberg* and Bertkau (*A*, p. 361) have shown that *Catadysas pumilus*, Hentz, which Hentz† classed with the Territelariæ, although this spider has only *two* air-sacs, cannot belong to that tribus (it belongs probably, as Holmberg thinks, to *Zora* or to an allied genus), and that Hentz's description and figures of the mandibles and maxillæ of *Catadysas* must be erroneous, the most important reason for regarding the Territelariæ as a group of only about equal value with the other tribus, and as united with the other spiders by transition-forms, no longer exists. They now show themselves to be very sharply distinguished from all other spiders, and I do not hesitate to admit that they may be considered a group of higher rank than the others, which in their turn may be united into a group of the same dignity. For these higher groups or *suborders*, the old Latreillian names Tetrapneumones and Dipneumones may be readopted. The suborder Dipneumones, then, would consist of the six tribus Orbitelariæ, Retitelariæ, Tubitelariæ, Laterigradæ, Citigradæ, and Saltigradæ; the suborder Tetrapneumones, on the contrary, consists as yet only of *one* such group, the Territelariæ, from which, however, the Liphistioidæ might perhaps be separated and made the type of a separate tribus‡. When Bertkau says that "the family Theraphosoidæ alone shows nearly all those diversities that have been observed within the Tristicta" (*A*, p. 361), this is, no doubt, an exaggeration; I cannot find that within the whole suborder Tetrapneumones there exist such widely dissimilar forms as, for instance, *Gasteracantha* and *Attus*, or *Ulesanis* and *Pholcus*. But that the Theraphosidæ, Auss., ought to be divided into several *families*, there is no doubt whatever §.

* "Observations à propos du sous-ordre des Araignées Territélaires (Territelariæ), spécialement du genre Nord-américain *Catadysas*, Hentz, et de la nouvelle famille Mecicobothrioidæ," in Boletin de la Academia Nacional de Ciencias en Córdoba (República Argentina), iv. p. 153 (1882).

† "Descriptions and figures of the Araneides of the United States," in Boston Journal of Natural History, vi. p. 287, pl. x. fig. 16 (1850).

‡ Compare Thorell, "Studi sui Ragni Malesi e Papuani. IV. Ragni dell' Indo-Malesia," in Annali del Museo Civico di Storia Naturale di Genova, xxiii. (ser. 2, iii.), 1886 (in the press).

§ See Thorell, *ibid.*

3. It by no means rarely happens that in groups that are highly specialized and very rich in species no sharp limits can be drawn between the different lower groups into which they must be divided. This must especially be the case with the order of the Spiders, on account of the peculiarities in the bodily structure of these animals, peculiarities of which we have spoken above (p. 306), and which make their classification so difficult. Even amongst the most natural coordinate groups we find examples of some one of them being united with another by "transition-forms" the systematic position of which must, by sad necessity, be more or less uncertain; and the consequence of this is, that when we have, for some practical purpose (as in my work 'On Eur. Spid.'), to define such groups by means of a single or a few characters, these become either artificial or of subordinate weight, or even assume a negative form. Such groups (and to them belong the tribus of the Dipneumones) should therefore, as has already been insisted upon, rightly be determined by means of a more *detailed* exposition of the structure of their different parts, with indications of the *exceptions* from all the characters given. And it will then be the preponderating *importance* and *number* of the characters by which a given form, for instance a genus, agrees more with the one than with the other of the groups in question, that decides to which of them it ought to be referred. In such cases the choice sometimes depends on individual appreciation, and the systematic place of the genus may thus appear to be "vacillating;" but this cannot well be avoided, nor would it seem to be of much consequence. Though, for instance, the Laterigradæ are a natural group, it is scarcely possible to draw a sharp limit between them and the Tubitelariæ, or rather between the Heteropodoidæ (Sparassidæ, *Bertk.*) and the Drassoidæ. Through the Thomisoidæ, the Laterigradæ also approach the Epeiroidæ of the tribus Orbitelariæ. The Lycosoidæ are not only nearly allied to the Drassoidæ (*Zora*, for instance), but they pass (through, for instance, *Sphedanus*, Thor.) gradually and almost imperceptibly into the Agalenoidæ, and might therefore *seem* to be more closely allied to this last-named family than to the Oxyopoidæ, which belong to the same tribus as the Lycosoidæ (Citigradæ), nay, are even regarded by Bertkau as a mere *sub*family of the Lycosoidæ. Epeiroidæ and Theridioidæ are held to be different families even by Bertkau, notwithstanding that he considers (*A*, p. 401) "the different form of the *web* to be the essential and most important character by which these two families may be distinguished from one another." I think therefore that it would scarcely be just to reject the old and

most generally received classification on the ground of the imperfections of which I have now spoken.

4. As to the *denominations* of the different tribus, they are quite as appropriate as many others in constant use in zoology. Mammalia, Reptilia, Amphibia, Carnivora, Oscines, &c. are generally received names, notwithstanding that they express *biological* characters, and although there are "Amphibia" which live only in water, "Oscines" that do not sing, &c. The great majority of the Orbitelariæ are really "round-web" spiders; almost all Retitelariæ make more or less irregular nets; most, if not all, Citigradæ are fast runners; almost all Saltigradæ jump, &c. No reasonable objection can therefore be raised against the names Orbitelariæ &c., unless it were necessary to discard *all* such names of zoological groups as are taken from biological characters, or that do not suit *all*, but only the greater part, of the forms that belong to the group in question. But I do not think that any one will urge against such names any wholesale doom of condemnation.

I have now gone through and examined the criticisms which Bertkau has formulated against the principal traits of the classification of Spiders at present most in vogue, and have endeavoured to confute them, in so far as they appeared to me unfounded. I have tried to show that the deficiencies which, without any doubt, are to be found in this classification, have in a great part their source in the difficulties inherent in the subject itself, and depending on the peculiar organization of the Spiders, difficulties which it will therefore probably not be possible to conquer completely. In part these deficiencies may be overcome by dividing the order of Spiders into two suborders, *Tetrapneumones* and *Dipneumones*, and these latter into the six tribus *Orbitelariæ*, *Retitelariæ*, &c. (or into a greater number of tribus if this should be considered more convenient), as also by characterizing these groups by means of more detailed diagnoses, instead of by isolated characters, as is the case, for instance, in the modern and often useful, but not equally scientific, "analytical tables"*. In the details of the system, as in the limitation of the families, and in assigning the right place to several among them whose affinities were contested or wrongly interpreted, many corrections have already been made by Dr. Bertkau, and many others may still remain to be carried out. By con-

* In his "Analytische Uebersicht der europäischen Spinnenfamilien" ('Mittheilungen des naturwissenschaftlichen Vereins für Steiermark,' Jahrgang 1877), Ausserer has, with fine tact, omitted to try to characterize the different tribus (suborders).

tinuing, in this way, to build on the old ground, it would seem that arachnologists might gradually draw nearer and nearer to the point aimed at—a fully natural classification. This point is aimed at by all the different zoological departments, and by Zoology as a whole; nay, such a classification may be said to be the final end of this science, inasmuch as the "system" is, as it were, a compendium of all that is known about the natural objects in question; and a fully natural system presupposes complete knowledge of their natural history in its whole compass.

Bertkau's opinion is, on the contrary, that the present arrangement of the Order of Spiders must be abandoned, as being fundamentally erroneous, and new principles laid down for the classification of these animals. He says that, in contradistinction to former arachnologists, he has in his new system of classification taken into consideration all the modifications in the structure of Spiders that are known to him, laying more stress on the differences in the organs of respiration than has been in general the case, and making use of characters taken from the form of the web only in case of need (*A*, p. 354). The principal difference, in this respect, between the classification proposed by Bertkau and that of other more recent arachnologists would, in fact, seem to consist in his having, in characterizing both suborders and families, attributed greater importance to differences in the inner anatomical structure than is generally the case, taking into consideration, in the first place, the different structural features of the organs of respiration, and, in the second place, the organs of generation. In his characterization of the *families*, the different shape of the tubular tracheæ (which are sometimes ramified either in the form of a tree or in the form of a bundle, and sometimes quite simple and unramified) plays an important part. Now as the Arachnida may be divided into two great groups, according as they breathe with (tubular) tracheæ* alone, or with air-sacs either alone or in combination with (tubular) tracheæ, it might have been expected that

* If, as is most generally believed, the lamellæ of the air-sacs are nothing but modified ordinary or tubular tracheæ, then the Arachnida which breathe with these latter organs must be older than, as they no doubt are inferior to, those which breathe with air-sacs; some authors, however, regard these last-named Arachnids as the more original forms, and as being directly descended from the fossil Eurypterids, the gills of these Crustaceans having been directly transformed into the air-sacs of the Arachnida (the Scorpions). How this supposed change came to pass it is not easy to understand; in the meantime we possess no less than *four* different hypotheses for explaining it—one proposed by MacLeod, two by Ray Lankester, and one by Kingsley!

Bertkau, when he drew the characteristics for dividing the Spiders into two suborders from differences in their breathing-organs, would, in conformity with Dufour, have divided them into such as breathe only with air-sacs, and have *two* pairs of these organs, and those in which the posterior pair of air-sacs is replaced by tracheæ, and which therefore have only *one* pair of air-sacs. But instead of that he has, as I have already stated, chosen as the chief basis for his classification the number of the openings through which these different organs of respiration communicate with the exterior, and thus divided the Spiders into the two suborders, *Tetrasticta* with *four*, and *Tristicta* with *three* breathing-holes or *spiracles*. Accordingly he has separated the Dysderoidæ from the rest of the Spiders that have only one pair of air-sacs, or the Dipneumones, and united them with the Tetrapneumones or Territelariæ in his suborder Tetrasticta. But this new arrangement does not appear to be at all a natural one; the different number and position of the spiracles have not nearly the great systematic importance that Bertkau attributes to these characters. How untenable, in fact, is the basis for his two suborders, is demonstrated by the fact that Bertkau refers to his Tristicta two genera belonging to two widely different families, viz. *Pholcus*, Walck. (*A*, p. 398) and *Ctenium*, Menge*, in which, according to Bertkau's own discoveries, the unpaired spiracle and its tracheæ are completely *wanting*! Consistently he ought to have formed for the reception of these spiders a separate suborder, *Disticta*; but he would then have been obliged to separate *Ctenium* from the rest of his Therididæ, and to place this genus in the vicinity of *Pholcus*†, which, of course, could not be done in a "natural" classification. As to the *unpaired* spiracle, it no doubt corresponds to the two posterior spiracles in the Dysderoidæ, or, in other words, *the two posterior spiracles of the Dysderoidæ are in the Tristicta moved more or less backward, and are more or less intimately united with each other.* This is proved not only by the fact that the unpaired spiracle is often, especially when situated further forward, evidently formed of *two* coalesced spiracles, but also by the tracheæ which debouch through this spiracle being, as in the Dysderoidæ‡, one or two on each side, though in the

* See [Förster and] Bertkau, "Beiträge zur Kenntniss der Spinnenfauna der Rheinprovinz," in Verhandl. des naturhist. Vereins der preussischen Rheinlande und Westfalens, Jahrg. xl. (4 Folge, x.), p. 349 (1883).

† Bertkau remarks (*A*, p. 398) that the tarsi of *Pholcus opilionoides* are subdivided into a rather large number of small joints; the same had been shown to be the case in *Ph. pullulus*, Hentz. See Thorell, "Descript. of the Araneæ collected in Colorado, &c.," *loc. cit.* p. 488.

‡ Compare Menge, 'Preussische Spinnen,' pp. 298 and 300.

Tristicta they often unite into a single short stem before entering the common spiracle. The identity of the posterior spiracles in the Dysderoidæ and the unpaired spiracle in the Tristicta also explains why the *unpaired spiracle is always wanting in the Dysderoidæ* (as well as in the Territelariæ). The position of this spiracle when present is, as is known, very variable; in general it is drawn backwards to the vicinity of the spinners, but sometimes it has its place much more forward, nay, even in the vicinity of the rima genitalis, just as is the case with the posterior spiracles in the Dysderoidæ. That the unpaired spiracle in the group Anyphæninæ, *Sim.* (which Bertkau, on the strength of its arborescent tracheæ, separates from the Drassoidæ, making of it a separate family), is situated sometimes very far from the spinners, sometimes in their vicinity, shows clearly enough the little importance of the position of this spiracle.

Bertkau himself does not always consider the position of the unpaired spiracle and its tracheæ to be of much systematic importance; he even refers to the same *genus* (*Argyroneta*) two species, in one of which, the *A. aquatica* (Clerck), the two stems of the tracheæ have their opening immediately behind the rima genitalis and penetrate through the petiolum into the cephalothorax, there dividing into a bundle of fine tubuli; whereas in the other (fossil) species, *A. antiqua*, v. Heyd., the spiracle is, according to Bertkau, situated in the posterior third of the abdomen, while the tracheæ do not enter the cephalothorax, but divide into a bundle of tubuli before reaching the petiolum*.

Even the *paired* spiracles of the Tristicta, by which the air-sacs debouch, and which are in most cases situated near the base of the abdomen, may sometimes be thrust far backwards; in *Tetrablemma medioculatum*, Cambr.†, for instance, they are situated far behind the middle of the abdomen, and are, moreover, placed very near to one another.

That the different form of the *tubular tracheæ* does not always offer a reliable characteristic for distinguishing closely allied families, is seen by the fact that Bertkau has been obliged, on the ground of such differences, to separate the genera *Thanatus* and *Tibellus* (*Metastenus*, Bertk.) from the other Thomisoidæ, and to refer them to the Heteropodoidæ

* See Bertkau, "Einige Spinnen und eine Myriopode aus der Braunkohle von Rott," in Verhandl. des naturhist. Vereins der preussischen Rheinlande und Westfalens, Jahrg. xxxv. (4 Folge, v.), pp. 357 and 358 (1878).

† "On some new Genera and Species of Araneidæ," in Proceedings of the Zoological Society of London, 1873, p. 114, pl. xii. fig. 1.

(Sparassidæ), which are well distinguished from the Thomisoidæ by the form of the parts of the mouth (especially the tooth-armature of the mandibles), the low clypeus, &c.* Would it not have been better to have written, in the diagnosis of the "Thomisidæ," "Die 4 Tracheenschläuche verästelt (selten einfach)," instead of "Die 4 Tracheenschläuche verästelt," quite as well as Bertkau, in his diagnosis of the "Lycosidæ," says, "Augen in 3 (selten in 4) Reihen gestellt"? Or are the structural characters to be considered invariable only because they are taken from internal organs? It would, on the contrary, seem that within the province of the Arthropoda in general, the characteristics given by the inner structure are by no means more important or more constant than those taken from the external parts. This has been remarked already by Sundevall†, who has strengthened his opinion with examples taken from the insects. And that also within the class Arachnida, both anatomical and embryological characters may be very different in closely related forms is seen, for instance, from the fact that within a group so compact and so little differentiated as the Scorpions, the first abdominal ganglion is, according to Ray Lankester‡, in the family Buthoidæ (An-

* Compare Simon, "Révision de la famille des Sparassidæ," in Actes de la Société Linnéenne de Bordeaux, 1880.

† "Svenska Spindlarnes Beskrifning," *loc. cit.* p. 192.

‡ In a treatise with the title "On the Muscular and Endoskeletal Systems of *Limulus* and *Scorpio*; with some Notes on the Anatomy and Generic Characters of Scorpions, by E. Ray Lankester, assisted by W. B. S. Benham and Miss E. J. Beck: Part V. Notes on Certain Points in the Anatomy and Generic Characters of Scorpions, by E. Ray Lankester" ('Transactions of the Zoological Society of London,' xi. part 10, 1885), this author has proposed a new classification of the Scorpions, which cannot fail to cause some surprise among arachnologists. "No writer on Scorpions," says he, "has given consistently a clear statement or (what is more to be desired) good figures of the really important structural features of the genera, subgenera, and species proposed or recognized by him; and it is with the object of pointing out *what* are the important points in which Scorpions may vary that the present remarks are published." Among the *fifteen* points enumerated as important by Prof. Lankester, no less than *eleven* would, however, seem to have been duly appreciated by his predecessors; the remaining four are:—(*a*) the above-named different disposition of the abdominal ganglia and of the great nerves of these; (*b*) the different sculpturing or ornamentation of the lamellæ of the air-sacs; (*c*) the shape of the spiracula, which are *oval* in "*Euscorpius*," *slit-like* in "*Buthus* (*Heterometrus*, Ehr.)," and *circular* in "*Brotheas*" (of the shape of the spiracula in the "Androctonini" nothing is said); and (*d*) the "chitinization of the genital operculum, whether in two quite separate plates, as in *Brotheas*, or in one imperfectly divided plate." Chiefly on the strength of the points (*a*) and (*b*) Prof. Lankester divides the order of the Scorpions (which according to him form a single family) into two *subfamilies*—I. Scorpionini (= Scorpionini + Telegonini, Peters) and II. Androctonini (= Androctonini + Centrurini, Peters). To his

droctonoidæ) situated in the *fourth* abdominal segment, whereas in other scorpions it is, on the contrary, placed in the *third* of these segments—a peculiarity which in the Buthoidæ necessitates a different origin, from that in other scorpions, of the nerve-stems which go to the two first pairs of air-sacs; and while the embryos of *Pandinus africanus* are developed in separate cæca of the ovarian tubes, and are provided with a long apophysis, proceeding from the mandibles, the embryos of *Buthus* (*occitanus*) and of *Euscorpius* are devoid of this apophysis, and perform their whole development in the interior of the ovary itself*. The case is no doubt the same, within the order of Spiders, with the characters derived from the form of the tracheæ and other internal organs, as with those taken from the external parts, or which have been found in their habits and instincts; in the same way as there are Orbitelariæ that do *not* construct a web, or only an irregular one, Lycosoidæ with only two tarsal claws (for instance *Thasyræa*), Pholcoidæ with only six eyes (*Spermophora*), Theraphosoidæ (Theraphosinæ, Auss.) with six spinnerets (*Hexathele*) or with only six eyes (*Masteria*), nay even Theridioidæ with only two spiracles (*Ctenium*), so there *may* be Thomisoidæ with simple, unramified tracheæ, Drassoidæ and Theridioidæ with a more highly developed system of tracheæ, &c.†

Scorpionini only *two* genera belong:—1. *Scorpio* (with the subgenera *Euscorpius*, *Buthus*, and *Brotheas*, and *perhaps* also *Hemiscorpion* and *Opisthophthalmus*), and 2. *Telegonus*. The Androctonini form a *single* genus, *Androctonus* (with the subgenera *Prionurus* and *Centrurus*). It is therefore quite natural that Prof. Lankester regards Peters's classification of the Scorpions as a failure, and the genera adopted by him as "in most cases unnecessary, often not even justifiable as subgenera." On *my* attempt to develop this classification he says, "Thorell has added a number of genera to the already superfluous list, and has modified Peters's classification in what appears to me to be a retrograde spirit"; and, further, "Dr. Thorell has carried the formation of genera and subgenera too far." To this I will only reply, that I have *never* proposed or adopted a *subgenus*, and that I do not understand why Prof. Lankester has done *me* the honour of mentioning my name; for as he is of course well acquainted with the works of all more recent authors in the field he treats of, he cannot be ignorant that other arachnologists, and especially *Simon* and *Karsch*, have increased the number of genera adopted by Peters and myself by a great many new ones, and that these authors therefore, more than I, are guilty of having modified the classification of the Scorpions in what Prof. Lankester considers a "retrograde" spirit. By going a little further in the opposite direction, or that now commenced by Prof. Lankester, one will, it is true, sooner and more easily arrive at a solution *ne ultra* of the problem how to divide the Scorpions into natural families and genera.

* See, for instance, Metschnikoff, "Embryologie des Scorpions," in Zeitschrift fur wissenschaftliche Zoologie, xxi. 1870.

† I may be allowed here to mention a reason against laying, in the

The importance in the modifications in the *organs of generation* also appear to me to have been somewhat overestimated by Bertkau. That in the Dysderoidæ the testes and the ovaries are united so as to form a ring*, just as in the Tetrapneumones, is a fact that shows, in combination with certain other features in the organization of the Dysderoidæ, that these spiders are more allied to the Tetrapneumones than are the other Dipneumones or Tristicta; and this is also generally admitted. But to draw from these resemblances the conclusion that they are more nearly related to the Tetrapneumones than to the Tristicta is, I think, erroneous, as the Dysderoidæ agree with the Tristicta not only in the direction in which the claw of the mandibles moves, and in the number of the joints of the inferior spinners, but also in their having only *one* pair of air-sacs—a character which, as I have already remarked, ought to have been, more particularly with Bertkau, of the most essential importance, and ought to have prevented him from separating the Dysderoidæ from the other Dipneumones and uniting them with the Tetrapneumones. That the Dysderoidæ have, in their general habitus, a striking resemblance with many Drassoidæ, cannot well be denied.

A character which, in Dr. Bertkau's classification, is of a certain importance for the limitation of the *families*, is taken from the different number (and the form) of the female's *receptacula seminis*. Thus the Tetragnathoidæ (Pachygnathidæ, *Bertk.*) differ from the Epeiroidæ and the Theridioidæ in having *three* such receptacles, not *two* only (*A*, p. 401). Their common opening is situated, together with the orifice of the oviducts, far (more or less) behind the spiracles; and this

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characterization of the different spider-groups, the chief stress on anatomical features, as this reason may to many persons seem to be of great weight, viz., the practical difficulties of determining, by means of such features, the systematic place of an unknown spider. And that these difficulties really exist, is seen, for instance, from the fact that many of the statements concerning the structure of the respiratory organs &c. given by such an experienced anatomist as Menge are, by Bertkau, shown to be erroneous. Moreover, it will, with the method in question, often be necessary to destroy the specimen that is to be determined, even in those cases where it belongs to a very rare species, or is a "unicum," and this is also a drawback of practical importance. But it may be objected against these remarks, that the aim of a natural system is not that of facilitating the determination of the different species, but of giving an expression of their real affinities; and this is true—though there might perhaps be found some means of reconciling both these claims. At least it would seem that if an anatomical feature really is of great systematic importance, there exists also some external feature that corresponds to it.

* In *Tegenaria domestica* also the ovaries form, even till shortly before the maturity of the animal, a perfect ring (see Dahl, "Analytische Bearbeitung, etc.," *loc. cit.* p. 4).

"vulva" is not chitinized, but destitute of those horny parts which in descriptive works is generally called *epigyne* (*saro*, Menge). As this character in the female corresponds with a peculiarity in the shape of the male palpi (their tarsal joint has in *Tetragnatha* and *Pachygnatha* a long movable hook jointed to its base, which is absent in the males of the true Epeiroidæ*), it may be reasonable to separate the Tetragnathoidæ, *Menge*, with *Pachygnatha*, from the Epeiroidæ, as a separate family. *Pachygnatha* is, however, on the other hand, very nearly related to certain spiders generally included in the genus *Meta*; this is shown, for instance, by the *Pachygnatha Vethii*, Van Hass.†, which is not a *Pachynatha*, but a true Epeiroid. An unchitinized vulva is also found in all Territelariæ, Dysderoidæ, Filistatoidæ, and Scytodoidæ, the males of which groups are distinguished by their simple, completely chitinized palpal bulbus; but the bulbus has this same structure also in certain Epeiroidæ, as *Nephila* and *Nephilengys*, the females of which have a chitinized vulva; and these modifications in the organs of copulation appear therefore, curiously enough, to be of rather subordinate importance.

As we have already seen, Bertkau divides his Tristicta into two great groups, *Cribellata* and *Meromammillata*, according as they are provided with, or destitute of, the unpaired spinning-organ called by Blackwall *cribellum*, the presence of which is always united with that of a number of peculiarly formed and symmetrically disposed hairs on the metatarsi of the last pair of legs, forming the organ called by Blackwall the *calamistrum*. All spiders which possess these organs were by Blackwall united into *one* family, the Ciniflonidæ, and Bertkau has now not only gone back to Blackwall's opinion of the systematic value of the organs in question, but has raised the Ciniflonidæ or Cribellata into a group of higher rank, divided into no less than nine families (*B*, p. 337)—Zoropsididæ, Miagrammopidæ, Filistatidæ, Œcobiadæ, Dinopidæ, Uloboridæ, Dictynidæ, Eresidæ, and Amaurobiadæ. Now it may at first view appear strange that not all, or at least many, of those arachnologists who have occupied themselves with the classification of the Spiders have maintained Blackwall's Ciniflonidæ as a family, or even as a group of higher rank; more especially as the cribellum and calamistrum are not only of importance in the economy of these animals, but the cribellum, as Bertkau remarks (*B*, p. 339), "is not an ordinary pair of spinners,

* See Emerton, "New England Spiders of the Family Therididæ," in Transactions of the Connecticut Academy, vi. pp. 207, 208 (1884).

† Midden Sumatra, Reizen en Ondersoekingen der Sumatra Expeditie, etc. iv. 11, *A*. Araneæ, p. 32 (1882).

but an organ of quite a peculiar nature, and at the same time brings along with it the presence of another organ, the calamistrum." But notwithstanding this, and though it is by no means difficult to ascertain the presence or absence of the organs in question, the difference in this respect has not, in general, been considered a character of greater value than those on which subfamilies and genera are founded. The reason appears to be not only that of two in other respects closely allied species the one may possess, the other want the cribellum and calamistrum, but also that the other parts of the spinning-apparatus have been found to vary most materially within very nearly allied groups of spiders. The *number* of the spinners may in fact vary in the most extraordinary way. Within the family Theraphosoidæ (=*Theraphosini*, Auss.), which is characterized, among other things, by having only *four* spinners, there is, however, as has been said above, *one* genus, *Hexathele*, Auss., which has *six* spinners; within the genus *Storena* of the family Zodarioidæ (one of the most natural families in the whole order) there are not only species with all the six spinners well developed, but others in which the intermediate ones are rudimentary, or wanting, in *one* of the sexes alone; in some Zodarioidæ *both* sexes appear to be destitute of the intermediate spinners. In most Zodarioidæ the *inferior* spinners are much longer than the superior, in others these four spinners are of about the same length; sometimes (not always) the two inferior ones are fixed on a common basal part. In the Agalenoidæ the *superior* spinners are in general much longer than the inferior, and their second joint provided with tubuli textorii along its whole underside; but in some cases the superior spinners are only of the same length as, or shorter than, the inferior, and are provided with tubuli textorii only at the apex; sometimes (*Cybæus*) their second joint is rudimentary, &c. That the spiders which are provided with cribellum and calamistrum do not form a natural unit is admitted even by Bertkau (*A*, p. 386). Nor does he deny that spiders belonging to the two different groups Meromammillata and Cribellata may show an "outer resemblance" to each other—and it would indeed be difficult to deny that *Zora* is like *Zoropsis*, or that *Cœlotes* and *Cybæus* resemble *Amaurobius*; but, says he, "this external resemblance does not prove anything as to the natural affinity more than the habitual resemblance of the shrew to the mice, or that of the blind-worm or the eel to the serpents, &c." (*B*, p. 340)—expressions which appear to me strange, to say the least. Or can it really be Dr. Bertkau's opinion that the presence or absence of a cribellum and calamistrum is of the same systematic

importance as the radical differences in the *anatomy*, and even in the external appearance, that exist between a fish and a reptile, between the eel and the serpent? To me it seems impossible to prove that the presence of the spinning-organs in question is a surer indication of affinity in those spiders which possess them than are most other structural features, anatomical or external. Rather the reverse might be supposed to be the case, from the fact that it is only the adult female and the young of both sexes of the Cribellata that are provided with the cribellum and calamistrum, whereas in the *adult males* these organs are rudimentary or totally wanting. The cause of this dissimilarity is of course this, that the adult males have no need of the apparatus in question, as they do not construct a web. And this again appears to me to prove that the cribellum and calamistrum are organs that have originally belonged to the order of Spiders in general, and have in the course of time been reduced and lost in a part of them, those namely which no longer wanted them; and this quite independently of their greater or less affinity. Thus it is easy to understand why we find these organs still in existence in spiders belonging to very dissimilar groups, and also why they are *always wanting in those spiders which lead a roving life and make no webs.* The possibility of explaining, on this hypothesis, the presence of the cribellum and calamistrum in spiders which in all other particulars are widely different from each other has not escaped Bertkau. "The systematic significance of the above-mentioned organs," says he, "might only be doubted in case that *all* spiders had possessed this fourth pair of spinnerets, but had, with the exception of some few genera, lost them in the course of time" (*B*, p. 339). But he does not show why this can*not* be the case, nor does he say anything more on the subject.

For my part, then, I cannot acknowledge in Bertkau's Cribellata and Meromammillata two *natural* or systematic units; but I think that these denominations may, nevertheless, be of practical utility for designating the spiders in which the cribellum (and calamistrum) is present or is wanting. It would perhaps be better, however, to call them (Araneæ) *Cribellatæ* and *Ecribellatæ*—the Cribellata possessing jointed spinners, or being "meromammillata"* quite as much as the other spiders. As to the families into which Bertkau has divided his Cribellata, some of them are no doubt so closely related to certain ecribellate families, that they could well be united with them. But on the ground of the modern, more and

* I suppose, in fact, that the word *Meromammillata* is formed of *μέρος*, part (joint), and *mammilla*. The term *Ecribellatæ* is formed in analogy with *elapidatus*, *exonerutus*, &c. Compare also *Evertebrata* and *Vertebrata*.

more increasing splitting up of the older families into numerous new groups of the same denomination, it may perhaps not be inappropriate to regard the presence or absence of the cribellum and calamistrum as a character sufficient to distinguish *families*; and it must then be admitted that all the cribellate families adopted by Bertkau are good systematic units, though I, for my part, should prefer to unite his Dictynidæ and Amaurobiadæ in one family, Dictynoidæ, these two groups being only distinguished by the different development of their tracheæ. Now as to the distribution, among the generally received tribus, of Bertkau's nine cribellate families, they must be referred partly to the Orbitelariæ, partly to the Tubitelariæ; as yet there is no example of a cribellate spider belonging to any of the other tribus. To the Tubitelariæ belong the Zoropseoidæ, which are closely allied to the Drassoidæ; the Dictynoidæ (inclusive of the Amaurobiadæ, *Bertk.*), which are nearly related to the Agalenoidæ; the Eresoidæ, which, though very peculiar, may, as Bertkau thinks, be placed in the neighbourhood of his Amaurobiadæ; the Œcobioidæ, which appear to have their nearest allies in the Urocteoidæ; and probably also the Filistatoidæ, which among the Cribellatæ are completely isolated, and have their allies among the Ecribellatæ, approximating in some respects to the Drassoidæ and the Scytodoidæ, and even to the Territelariæ.—There remain to be taken into consideration the Dinopoidæ, Miagrammopoidæ, and Uloboroidæ. The Dinopoidæ, whose systematic position has been so contested, and which I had formerly placed in the neighbourhood of the Agalenoidæ, would seem, on the strength of the important reasons alleged by Bertkau (*B*, p. 353 *et seq.*), to have their nearest allies in the Miagrammopoidæ and Uloboroidæ; as an additional reason for assigning this place to this family may be adduced the presence (at least in *Dinopis camelus*, Thor.) of so-called accessory or auxiliary tarsal claws, which, so far as I know, have only been observed in the Orbitelariæ and in part of the Retitelariæ. That the Miagrammopoidæ are allied to the Uloboroidæ is generally admitted. It therefore only remains to show that the Uloboroidæ should be placed in the tribus Orbitelariæ; for if this is settled, the two last-named families will, of course, follow along with them. Now it is in the first place a fact (which Bertkau, however, appears to doubt) that *Uloborus* is a true round-web spider*; I have myself captured both *U. Walckenaerii* and *U. plumipes* in their circular, perfectly closed webs; and this fact is, I believe, one of the strongest proofs of the artificial

* See for instance Thorell, "Till kannedomen om slagtena Mithras och Uloborus," in Œfversigt af K. Vetenskaps-Akademiens Förhandlingar, xv. (1858), p. 194.

nature of the division of the Spiders into Cribellata and Meromammillata. Even if we do not assign, in general, any great weight in the phylogeny and classification of the Spiders to the form of their webs, it must be admitted that it is at least probable that spiders that fabricate regular or so-called geometrical webs have a common origin and belong to one and the same higher group, or, in other terms, that this industry cannot have arisen spontaneously and independently in two or more different and *natural* higher groups. What Bertkau has remarked (see above p. 322) as a proof of a close affinity between spiders with and spiders without a cribellum, may, with some modification and with more truth, be adduced as a reason for the affinity between the spiders which make circular webs. Only on the supposition that *all* spiders have originally constructed such webs, but that most of them have in the course of time lost this talent, could it be admitted that spiders belonging to radically different groups can give their webs such an artistically finished and almost identical form. But for such a supposition there is no reasonable ground. It may be uncertain which of the actual spiders are most nearly related to the original ones—whether it be the Territelariæ, or the Tubitelariæ, or another group; but that the first spiders were Orbitelariæ, nobody will, I believe, think possible. In the case before us, the form of the web appears to me to be of such importance that it can scarcely be overestimated. Moreover, the typical Uloboroidæ, *i. e.* the genus *Uloborus*, has so many *structural* features in common with the Epeiroidæ and Tetragnathoidæ, that also in this respect there is nothing that militates against the uniting the Uloboroidæ with these families in one and the same tribus. Any one who, without knowing the genus *Uloborus*, gets a specimen of this genus in his hand will, I believe, see that he has before him a spider that is related to *Epeira* or *Tetragnatha*. *Hyptiotes* deviates rather strongly both from *Uloborus* and from the Epeiroidæ, and demonstrates together with *Miagrammopes* and the Dinopoidæ, how materially even a natural group of spiders, such as the Orbitelariæ, may vary, both in its internal and external characters and in its industry.

From what I have here said, it will be seen that though I fully acknowledge Dr. Bertkau's merits in having given many most valuable contributions towards a more perfect classification of the Spiders, I cannot find that he has been successful in his attempt at laying down new principles for this classification. His chief groups, the Tetrasticta and the Tristicta, as also the Cribellata and the Meromammillata, and even the Perissonycha and the Artionycha, appear in fact to me to be rather artificial than natural units; and he has perhaps also

attributed too much importance to characters derived from the structure of some of the internal parts, especially the tracheæ.

It would of course be out of place to discuss here the value and systematic position of the different spider-families proposed of late years, and still more so to make any attempt at a complete classification of the Spiders, with an enumeration of all the different families and their characteristics; for such an attempt it is necessary to possess far richer materials, collected in all parts of the world, than are at my disposal. With the modifications for which we are indebted to Bertkau, and with those which I have permitted myself here to propose, the principal traits of the classification which, I think, would answer to our present knowledge of this Order of animals may, however, be seen from the following scheme, in which I have included as examples, besides the (recent) European families, only a few exclusively exotic ones.

Ordo ARANEÆ.
Subordo I. TETRAPNEUMONES.
Tribus I TERRITELARIÆ.
Fam. 1. Liphistioidæ.
2. Theraphosoidæ.
3. Atypoidæ*.
&c.

Subordo II. DIPNEUMONES.
Tribus II. TUBITELARIÆ.

Ecribellatæ.	*Cribellatæ.*
Fam 1. Dysderoidæ.	
	Fam. 2. Filistatoidæ.
3. Palpimanoidæ	
4. Myrmecioidæ.	
5. Drassoidæ.	
	6. Zoropseoidæ.
7. Argyronetoidæ.	
8. Agalenoidæ.	
	9. Dictynoidæ.
	10. Eresoidæ.
11. Zodarioidæ.	
12. Hersilioidæ.	
	13. Œcobioidæ.
14. Urocteoidæ.	

&c.

* The denominations Atypoidæ, Epeiroidæ, and Thomisoidæ ought to be changed (see Thorell, "Studi sui Ragni Malesi e Papuani. IV. Ragni dell' Indo-Malesia," *loc. cit.*). That in the names of the families the termination *-oidæ*, which was used by, for instance, Cuvier, is preferable to *-idæ*, I have shown in 'Remarks on Syn.' p. 590, as also in "Descrizione di alcuni Aracnidi inferiori dell' Arcipelago Malese," in Annali del Museo Civico di Storia Nat. di Genova. xviii. p. 35 (19) (1882).

Tribus III. RETITELARIÆ.

Fam. 1. Scytodoidæ.
2. Pholcoidæ.
3. Theridioidæ.
&c.

Tribus IV. ORBITELARIÆ.

Cribellatæ.

Fam. 1. Dinopoidæ.
2. Miagrammopoidæ
3. Uloboroidæ.

Ecribellatæ.

Fam. 4. Tetragnathoidæ.
5 Epeiroidæ.
6. Celænioidæ.
7. Cryptotheloidæ
&c.

Tribus V. LATERIGRADÆ.

Fam. 1. Heteropodoidæ.
2. Stephanopoidæ.
3. Thomisoidæ.
&c.

Tribus VI. CITIGRADÆ.

Fam. 1. Lycosoidæ.
2. Oxyopoidæ.

Tribus VII. SALTIGRADÆ.

Fam. 1. Attoidæ.

XXIX.—*Notes from the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).*—No. IV. *On a Male Tunny* (Orcynus thynnus, *L.*). By Prof. M'INTOSH, M.D., LL.D., F.R.S., &c.

[Plate XI.]

THE specimen was captured on the 16th October, 1885, by one of the ships of the General Steam Fishing Company of Granton, when trawling in the "Fluke-hole" or Traith in the Forth, off Pittenweem, in 15 fathoms, and was most courteously sent to the Marine Laboratory and the University Museum by Mr. Scott, the manager, who states that the fish was dead when the trawl (which had been down about four hours) was brought on board. A powerful fish like this would probably make desperate efforts in the net; yet the stout fins, though

showing evidences of friction, were comparatively little affected, the tips of the pectorals and the caudal rays chiefly suffering. This immunity was probably due to their strength and to the fact that the strong spines of the first dorsal and the whalebone-like stiffness of the second dorsal and the anal only proved impediments and sources of rapid exhaustion to the entangled fish.

The specimen was of good size, weighing about $6\frac{3}{4}$ cwt., and having a total length of nearly 9 feet from tip to tip *. The greatest girth was 6 feet 5 inches, in a line with the second dorsal and slightly in front of the base of the anal. The circumference at the base of the caudal, again, was only 11 inches. The other measurements were:—

	ft.	in.
Length from tip of snout to base of tail	7	10
Length from tip of snout to anterior border of first dorsal	2	6
Length from tip of snout to anterior border of second dorsal	4	5
From tip of mandible to base of pectoral......	2	2
From tip of mandible to margin of operculum	2	$3\frac{1}{2}$
Antero-posterior margin of gape (superiorly) ..	0	$7\frac{1}{2}$
Antero-posterior line to corner of maxilla	0	10
Vertical gape	0	8
Length of first dorsal	1	11
Height of first dorsal	0	$10\frac{1}{4}$
Length of second dorsal....................	0	9
Height of second dorsal along edge	1	$3\frac{1}{2}$
Base of pectoral	0	$4\frac{1}{2}$
Length of pectoral	1	5
Expanse near tip..........................	0	9
Ventral, base to apex	0	$10\frac{1}{2}$
Anal, breadth at base......	0	$6\frac{1}{2}$
Anal, base to apex	1	4
Expanse of caudal	2	10
Diameter of exposed region of eye, horizontal..	0	$2\frac{3}{8}$
Diameter of exposed region of eye, vertical....	0	$2\frac{1}{8}$

The colour of the dorsum was blackish, with hardly a tinge of bluish. The sides were greyish and the under surface white. No trace of stripes occurred in this example. The first dorsal had its spines black and the web dark brown; the second had its basal portion black and its apex yellowish. The pectorals were black, while the ventrals had the upper surface dark reddish brown and the under silvery, with brown between the rays; the edges were dark. The anal was silvery, with the anterior edge black. The finlets (accessory

* I have to acknowledge the aid kindly given me in measuring and note-taking by Mr. J. Wilson, Demonstrator of Zoology in the University.

fins), which were ten dorsally (the first, however, being appended to the base of the second dorsal) and nine (slightly larger) ventrally, had their bases reddish brown, shading off distally into bright yellow; the free edge has a dark-fringed margin ¾ inch deep. The caudal had the upper half black, with the frayed portions pinkish; the lower half showed a large amount of red or pink amongst the black portions, probably from injury.

The chief points in external configuration that fall under notice are the scales and fins. The former, with the skin, constitute a dense coat of mail (corselet) in front, and must form a very efficient protection *. The first dorsal fin again is stated to have weak spines †; but it is sufficient in this specimen at least to point out that all are unbroken, while the tough membrane between them is lacerated, and that the powerful nature of the first spine is conspicuous. It is slightly grooved posteriorly for the second spine, and the whole fin can be folded into a hollow. There is likewise a flattened depression for the pectorals, and this gives an indication of the length of these organs when entire.

The external form of the tunny has been represented by various authors, and comparatively recently by Mr. Day, in his excellent work on 'British Fishes' ‡. The figures available for comparison, however, differ so much from the specimen under consideration that a special sketch, aided by a photograph, was made by Mr. Wilson, Demonstrator of Zoology, and will be published in the 'Fourth Annual Report of the Fishery Board for Scotland.' The premaxillary and maxillary region is too long in the figures of Cuvier and Valenciennes §, as as well as in Day's, in which the upper outline of the snout is also too uniform; and in these and in Yarrell's ‖ and Couch's ¶ figures the eye is too large. The mandibular region is too narrow and elongated in all the figures except Couch's and the upper margin is too straight in profile. The shading of the head in Day's figure gives a somewhat peculiar aspect to the lateral view of this region, which seems to be too long from the tip of the snout to the posterior margin of the operculum; and the same may be said of Cuvier and

* The minute structure of these scales has been investigated by Prof. Quekett.

† *Vide, e. g.*, Gunther, Catalogue, ii. p. 362; Day, Brit. Fishes, p. 93.

‡ 'British Fishes,' ii. pl. xxxv. (1881). The earlier figures of Rondelet, Bélon, Salvien, Gesner, Duhamel, Bloch, and Pennant have been criticized by Cuvier and Valenciennes.

§ Hist. Nat. des Poissons (Paris, 1831), viii. pl. ccx.

‖ Brit. Fishes, 3rd edit. ii. p. 200.

¶ 'Fishes of the British Islands,' ii. pl. lxxxii.

Valenciennes's figure, the gape in both, moreover, being too long in its antero-posterior axis. The teeth are somewhat fancifully represented in all the figures, since they are much less distinct in nature. The spines of the dorsal fin are all of nearly equal thickness in the figure of the French authors and in Day's and Yarrell's, whereas, with the exception of the first, they are too thick in Couch's. They seem to have been unusually long anteriorly in the specimen figured by Day. The second dorsal fin has not been well represented in any of the figures, and it is much too broad and short in Couch's. The awkward flattening of the back along the base of the first dorsal fin in Day's figure is probably due to the taxidermist and is not found in nature or in the other outlines mentioned. The anal fin is also too short and broad in most of the figures, and Day's outline materially differs from nature in the relation of the second dorsal and anal fins to a vertical line. A line running vertically from the anterior margin of the anal falls behind the second dorsal; but in Day's figure it pierces the dorsal midway. The upper margin of the deep groove for the pectoral in a lateral view is generally seen above the somewhat straight edge of the pectoral; but this has not found its way into any representation. In none of these figures is the true shape of the finlets given, for in each a distinct elevation occurs in front and then a pointed process extends backward nearly parallel to the outline of the body; they are, in short, unequally bifid. The figure in Day's 'British Fishes' deviates considerably from life in this respect.

In the branchial chamber were numerous specimens of a *Caligus*, several examples bearing large tufts of *Obelia geniculata*, which seemed to flourish with remarkable vigour on so favourable a site. The hydrorhiza in some cases covers the ventral surface of the cephalothorax of the parasite with an intricate web of fibres, amongst which the feet can hardly be distinguished, while the dorsum of the same region is entirely shaded by a dense tuft of the polyparies, which are of great strength. In others the stolons spring from the abdominal region.

Digestive System.—The teeth appear proportionally small for so large a fish; they are slightly curved and turned inward and backward. A rasp-like surface occurs on the median hyoidean apparatus, and the sides of the tongue have a few horny processes. The mucous surface of the roof of the mouth has, in addition to the rasp-like teeth on the palatines, numerous hardened streaks from thin ossifications of the region.

The œsophagus is very short and wide, with muscular walls, and is deeply plicated longitudinally on the inner surface. It is about 8 inches in diameter at the cardiac end of the stomach. The surface near the latter is villous, but it is distinguished from the surface of the stomach by the greater number of rugæ in the latter.

The stomach is a large conical sac measuring 25 inches in length from the cardiac orifice to the apex posteriorly. Its inner surface is complexly rugose from longitudinal and transverse reticulations, and the contraction of the thick muscular mass in spirit considerably intensifies this feature. Externally the superficial muscular layer is chiefly longitudinal, then follows a series of circular fibres; while internally a layer apparently of interwoven fibres occurs, with much connective tissue. The whole forms a powerful muscular chamber, in which were three haddocks (11, 11, and 9 inches respectively), two lemon-dabs (9¼ and 8¼ inches), and two common dabs (each 7½ inches). While searching for these at the bottom of the water it had encountered the trawl-net. The pyloric region of the organ is situated about 3 inches from the cardiac opening and therefore near the œsophagus. The walls of the diverticulum leading to the pyloric valve are rugose and remarkably massive, especially at the termination, near which one large boss projects from the posterior wall of the canal. These thick folds form a very efficient valve, which arrests even small bones, such as the vertebræ of the haddocks and dabs, and in all probability peristaltic action sends them out of the mouth if bulky *, or they remain there till the gastric secretion disintegrates them.

At the cardiac end of the stomach were five examples of a large *Distomum*, apparently *D. clavatum*, Rud., a species which has been found in the stomach of *Pelamys sarda* and in the intestine of *Coryphæna hippurus* in the Mediterranean, as well as in the present form †. Amongst the mucus of the same organ were a large *Ascaris* (imperfect), two *Echinorhynchi*, probably from the haddocks or other prey, and a fragment of a mollusk from the same source.

The calibre of the duodenum at its commencement is comparatively small, and externally the distinction between the two regions is well marked on palpation. Beyond the prominent boss at the pyloric valve are a few longitudinal and oblique ridges of the canal; but these soon cease, and the proper duodenal region of the gut is smooth, with the excep-

* A common occurrence in fishes.

† Carus, 'Prodromus Faun. Mediter.' i. p. 131.

tion of faint longitudinal elevations. It is about 7 inches in length.

About half an inch behind the pylorus the thick wall of the duodenum is perforated by the comparatively small aperture of the gall-duct. On close examination the opening at the bottom of the pit, however, is found to be double. One aperture leads almost directly into a cæcal appendix nearly 3 inches in length, placed anteriorly close to the hepatic duct; while another, more oblique in direction, leads into the latter. Commencing next the gut, the narrow gall-duct shows a dilatation about half an inch in diameter about 2 inches from its origin. It again contracts after a course of 5 inches, and then dilates into a long sac of unequal calibre—2 feet 4 inches in length, besides a terminal appendix 1½ inch long. The remarkable length of the organ was even noticed by Aristotle. Three dilatations occur in the long sac, viz. a fusiform one 6 inches in length inferiorly, another, of the same shape, 12 inches long, and a more cylindrical terminal region, which also shows, however, a slight dilatation in the middle and an approach to a diverticulum at its commencement. Slightly contracted regions separate these divisions from each other. The bile has a dark green colour and is aqueous. The cæcal appendix is somewhat wider than the gall-duct at its base, dilates rapidly to almost double the diameter, and then diminishes to a conical apex. The walls of this cystic appendix are thinner than those of the duct, and the inner (mucous) surface is minutely speckled with blackish or dark brownish pigment-points. The gall-bladder again shows terminally a beak-like diverticulum of a conical form, which projects from the longitudinal axis of the organ at an angle. The inner surface is apparently smooth, though marked with minute black points, as in the foregoing sac, and the wall is comparatively thin. Under a lens a tendency to minute reticulation, however, is observed even in the distal region of the bladder, and after a course of from 15 to 18 inches down the organ such becomes more pronounced, and the wall at the same time increases in thickness. The latter is especially marked at the commencement of the dilatation, measuring 6 inches in length, for the wall is denser than that of the 12-inch distal dilatation. Where the 6-inch region contracts inferiorly prominent longitudinal rugæ appear and frequently run together, the intermediate spaces being finely reticulated. The reticulations are less pronounced in the narrow portion between this and the nearly cylindrical region (about 3 inches in length) inferiorly. The latter is marked throughout by longitudinal

ridges, which frequently run together, the intermediate surface being minutely reticulated. The ridges and reticulations keep the character just noted till within 4 inches of the gut, where the wall becomes denser, partly from the great development of the longitudinal ridges, which resemble folds like those of the "manyplies," so that only fluid will readily pass along. Under a lens the surface is still reticulated, but more minutely. These rugæ continue, in the forward course of the canal, through the wall of the gut to its termination in the pit. Thus the differences between the lining membrane of the gall-bladder, its duct, and the cystic appendix are marked, though the minute black specks are everywhere present.

Into the duodenum, which has about the same calibre as the rest of the gut, seven (Cuvier and Valenciennes say five *) large ducts enter from the great glandular pyloric mass, the cæca of which are about a line and a half in diameter. The first of these (having a diameter of half an inch) joins the canal about an inch from the pylorus; it consists of a main stem an inch in length, which splits dichotomously into a number of branches, each of which resolves itself into a carrier for a bundle of the ultimate cæca, fat, and connective tissue, forming a terminal process of about 3 inches in length. The second main duct enters the duodenum close to the foregoing, and it has a similar diameter, though the stem reaches the length of 3 inches. The chief branches are also much longer, so that the terminal cæca extend outwards about a foot from the gut, and thus permit a ready disposition of the parts in the abdomen. Further, the smaller branches are for the most part disposed on one side of the larger, so as to give a fan-like arrangement when they are stretched on a flat surface. The third is a short trunk (placed about half an inch from the second), which quickly divides into a large number of branches to the cæca, which thus approach the gut proximally (within 1¼ inch), but are nearly 3 inches distant terminally. The fourth duct is fully ¾ inch in diameter, and enters the duodenum about 1¾ inch further backward. After a short course of ¾ inch it breaks up into a number of branches, which chiefly spring from the anterior region. The fifth is an inch behind the preceding, and consists of a short wide tube (1 inch in diameter), which splits into a fan-like series of branches, the cæca being near the gut. The sixth (1 inch distant from the fifth) and the seventh (1½ inch behind the sixth) have similar short trunks with a fan-like distribution of their branches, the ultimate cæca in the latter being considerably shorter than in front.

* *Op. cit.* vol. viii. p. 65.

On the whole, the second duct is that which appears to have the largest collection of cæca, the first and fourth following next in order, and thereafter the fifth, sixth, third, and seventh respectively. In the interior of the ducts is a reddish gelatinous substance, which presents a granular structure with numerous oil-globules and opaque fatty concretions of a rounded shape.

The great mass of the pyloric cæca presents a cordate outline, the intestine entering the centre. It is 13 inches across the base, and from the latter to the apex measures 20 inches. It is invested by peritoneum, the edges of which show crenations, and in certain parts fimbriæ.

The intestine measures 5 feet from the end of the duodenum to the rectum. The entire surface is covered with a downy coat of villi about $\frac{1}{8}$ inch in length. No food was present amongst the masses of tough mucus. The peritoneal surface of the intestine and gall-bladder presents numerous black pigment-streaks and patches. The villi of the rectum were covered with bloody mucus. The diameter of the canal is nearly uniform.

One of the most interesting features in connexion with the liver and its vascular supply is the presence of the remarkable "Wundernetze" so ably described by Eschricht and Müller *. Four conspicuous examples of these occur in the hollow of the liver, along the wall of the stomach, just behind the œsophagus, besides some minor spindle-shaped processes, and at first sight their consistence and colour might readily cause them to be mistaken for splenic tissue. The first measures $3\frac{1}{2}$ by $2\frac{1}{2}$ inches, the second $4\frac{3}{4}$ by $2\frac{1}{4}$ inches, the third $5\frac{1}{2}$ by 3 inches at the widest part, and the fourth $2\frac{1}{2}$ by $1\frac{1}{2}$ inches. All are of a deep reddish colour, somewhat reniform in outline and present similar structure. Large blood-vessels, chiefly connected with the hepatic artery, enter them and split up into a closely arranged series of parallel vessels, so that the organs assume a fibrous appearance, and readily tear in the direction of the parallel vessels from edge to edge. In this instance the splitting was transverse or slightly oblique with regard to the long axis. In the smallest, on the other hand, the fibres ran in the direction of the latter. On examining a thin transverse section (*i. e.* across the long axis of the fibres and tubes) under a lens a closely arranged series of reticulations present themselves, a larger and a smaller being especially conspicuous (Pl. XI. fig. 1), this variation

* "Ueber die arteriösen und venösen Wundernetze an der Leber und einen merkwürdigen Bau dieses Organes beim Thunfische," Abhandl. der k. Akad. d. Wissenschaften zu Berlin, 1835, p. 1 &c.

being apparently due, in many cases, to the condition of the vessels as regards distention by blood. The vessels have a delicate translucent lining, apparently epithelial, and the muscular or elastic wall, chiefly composed of circular fibres, is of great thickness, and generally tinged reddish by the hæmoglobin. The vascular channels are bound together by granular connective tissue and cells, and it is this which gives way when the structure is torn longitudinally.

The size of the vascular channels is such that a large amount of blood must pass quickly through these organs.

The liver forms a large trilobate mass of a greyish-yellow colour. It has been described both by Cuvier and Valenciennes*, and by Eschricht and Müller†, the latter authors likewise giving very good figures of it. The margins in the present example show various lobules which range from ½ inch to 3 inches in length.

The spleen forms a great glandular organ of a dull reddish colour attached to the intestine behind the duodenum, and measures 22 inches in length by about 3 in diameter. It is firm and rather friable, somewhat resembling a fatty liver in section, the surface of the latter being dotted with large reddish-brown masses and more minute intermediate blackish specks. Microscopically it presents a uniform matrix of a minutely cellular appearance. The organ appears to have undergone considerable degeneration.

The male reproductive organs are attached to huge flattened fatty folds fully an inch in thickness, which occupy the posterior region of the abdominal cavity. Towards their anterior ends these folds are highly vascular, so that in minute structure the tips for a distance of 6 inches resemble that of a blood-gland, and they are of a deep red colour. The rest of the folds are fatty. Two or three minute ova, apparently parasitic, occurred in the dissection of these masses. The reproductive organs are separated from these folds by no distinct line of demarcation, but are closely connected with their outer borders. The organs measured respectively 2 feet and 1 foot 10 inches in length, by 3½ and 3 inches in breadth. In a transverse section through both parts it is easy to distinguish the more compact tissue of the reproductive organs; but the inner border of the fatty folds sends fibres and vessels into the reproductive organs, so that they are more or less continuous with each other. In minute structure they present a series of closely arranged transverse tubular folds. No sexual products are visible. The urinary bladder is a thick muscular organ of small dimensions.

* *Op. cit.* p. 66.

† Abhandl. Akad. Berl. 1835, p. 2 *et seq.* Taf. i., ii., u. iii.

The ventricle of the heart forms a great muscular triangle nearly 6 inches in its longer boundary, such as at the base or along the convex edge. This powerful muscular mass contains a comparatively small chamber which has an apical and two lateral diverticula besides the great channel into the bulbus. Each of these has various pits in the muscular walls. The external layers have their fibres mostly in the long axis of the sides, so that they are thus differentiated from the more transversely arranged inner region. The aperture into the bulbus is defended by the two great valves, and its whole inner surface is thrown into a somewhat symmetrically arranged series of elastic pouches, which by their disposition probably perform some of the functions of the Elasmobranch *conus*, since their posterior folds (Pl. XI. fig. 2, *a*, *a*) apparently form pockets in action. A similar condition is present in the swordfish, as represented by Dr. Günther*.

The auricle is a large and comparatively thick muscular chamber with a complex network of *musculi pectinati* scattered over the surface.

The large quantity of the circulatory fluid in this fish was very marked, especially as it remained fluid. The appearance of the muscles and other parts renders it probable that the species would afford interesting results in regard to temperature-observations. This is the more likely since Dr. John Davy found the temperature of the blood in the deep-seated muscles a little below (?) the gills in the bonito (*Thynnus pelamys*, Cuv. & Val.) to be 99° F., whereas the temperature of the surface of the water was in the region 80°·5 †.

The swim-bladder is 3 feet in length and upwards of a foot in diameter at its widest part. It has been briefly alluded to by A. W. Malm in his account of a specimen from the Skagerak ‡; but its interesting structure merits further study. In the abdominal cavity the organ is situated close above the intestine and other viscera, since the enormous subvertebral muscular masses occupy the dorsal region and considerably limit the space for its distention. Externally it has a peritoneal coat on its free surface. Internally the whole surface is beautifully reticulated by a vast series of raised whitish bands which inosculate with each other. The main series of these springs from the circumference of a large aperture (Pl. XI. fig. 3, *a*) an inch and a quarter in transverse diameter and an inch and a half in antero-posterior diameter, which seems to occupy the mid-dorsal region. The aperture, which is mentioned by Malm, is surrounded by a few warty processes,

* Introd. Study of Fishes, p. 152, fig. 68.
† Edinb. New Phil. Journ. vol. xix. p. 325.
‡ Göteborgs och Bohusläns Fauna, 1877, p. 415.

and leads into a large subperitoneal space. These bands spread in a radiate manner into the surrounding area, inosculating with each other early in their course, and by-and-by forming meshes (Pl. XI. fig. 4) all over the surface. The ribs of the meshes are especially strong in front, and most of the large meshes also occur in this region. Moreover, here and there certain thickenings of the elastic ribs occur, forming small solid nodes. As shown in the sketch (fig. 4) the larger meshes in front have their long axis antero-posterior, and each has either a central longitudinal rib with lateral bars, as in a leaf with its midrib, or numerous strong ribs bind the sides of the long meshes transversely. There is indeed great variety in regard to the arrangement of the central ribs and veins, but the whole presents an elaborate and sometimes a nearly regular series of reticulations. The latter closely approach the great aperture of the sac posteriorly, as indicated in the sketch (fig. 3). The general aspect of the inner surface of the air-bladder is thus less silvery than in many fishes, apparently from the predominance of the lustreless whitish ribs, and indeed is more evident on the outer surface of the ribs after the superficial fibres are removed. The raised ribs appear structurally to be modifications of the elastic tissue usually found in such organs.

The object of these varied reticulations and of the solid, firm, and elastic ribs is apparently to increase the strength of the huge air-sac without adding much to its bulk, while at the same time very great elasticity is provided for. The morphologist is likewise reminded by the leaf-like enclosed areas of the further development of the principle as observed in the lung-like organs of the Dipnoi.

When removing the muscles of the dorsum a tumour resembling a pheasant's egg in size and shape was found. It is solid and firm, presenting on section a border of blackish pigment and a whitish centre. Microscopically it is fibro-granular with many oil-globules, and the pigment is either in masses or scattered thinly in stellate corpuscles.

NOTE.—In my paper in the 'Annals' for June 1885, p. 433, line 1, *for* bubalis, *Bloch*, *read* scorpius, *L.*

EXPLANATION OF PLATE XI.

Fig. 1. Section across the long axis of a vascular *rete*. *a*, cavity of a great vessel; *b*, muscular (and elastic?) wall of the same; *c*, mass of blood-corpuscles; *d*, connective tissue. × 90 diam.

Fig. 2. Heart of the tunny reduced to somewhat less than half-size, and opened from the dorsal aspect. *a*, *a*, pouches in the *bulbus*

aortæ; *b*, the two aortic valves; *c*, remnant of the auricle; *d*, cavity of the ventricle, showing various diverticula. The great muscular walls are kept apart by a style.

Fig. 3. The aperture (*a*) of the air-bladder, with its neighbouring reticulations and radii. Considerably reduced.

Fig. 4. A few of the reticulations on the inner surface of the anterior region of the swim-bladder. Natural size.

XXX.—*Notes on the Palæozoic Bivalved Entomostraca.*— No. XX. *On the Genus* Beyrichia *and some new Species* *. By Prof. T. RUPERT JONES, F.R.S., and Dr. H. B. HOLL, F.G.S.

[Plate XII. †]

CONTENTS.

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* For No. XIX. see Ann. & Mag. Nat. Hist. for March 1885, p. 174.

† This Plate has been drawn under a grant from the Royal Society for the illustration of fossil Ostracoda.

INTRODUCTION.

In the Ann. & Mag. Nat. Hist. ser. 2, vol. xvi. 1855, pp. 81 *et seq.*, one of us gave a short history of this genus and a description of its characters *. Excepting that the group "*Beyrichiæ simplices*" now belongs to our genus *Primitia* †, there is not much to alter in the account there given, though many species have been added from several of the stages of the Palæozoic system of strata. We may remark, however, that we now prefer to regard them, together with *Leperditia*, as more closely related to Ostracoda ‡ than to Phyllopoda, to which order they were then referred with doubt (p. 85). Doubtless they are an ancient *generalized* group possessing characters since distributed among more special forms. The "*Cytheræ*" and "*Cytheropses*" mentioned at p. 84 are probably Cytherids or marine Cyprids and *Primitiæ*; and the *B. siliqua* (pp. 84 and 90) is a *Cytherellina* (Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 215).

It is important to notice an omission at p. 83, where it should have been stated that Dr. Ernst Boll, of Neubrandenburg, proposed "*Beyrichia*" in 1847 as a name for the genus independently of Prof. F. M'Coy, both having recognized that Prof. Beyrich first referred these little fossil organisms to their right systematic group. Dr. E. Boll § added much to our knowledge of the Upper-Silurian *Beyrichiæ* from the erratic blocks of Scandinavian limestones in North Germany.

Since 1855 the *Beyrichiæ* have been much studied. The observers have been Boll, 1856 and 1862; Schmidt, 1858; Römer, 1858; James Hall, 1859 (also before and afterwards); d'Eichwald, 1860; Billings, 1866; Bock, 1867; Heidenhain, 1869; Richter, Kolmodin, Linnarsson, and Karsten, 1869; Barrande, 1872; Krause, 1877; Haupt, 1878; Brögger, 1882; Kiesow, 1884; Reuter, 1885. These, besides others, including J. W. Kirkby and ourselves, have described and illustrated new or little-known forms. A very full account of the history of the genus up to 1872 will be found in the late M. J. Barrande's Syst. Sil. Bohême, vol. i. Suppl. 1872, pp. 484 *et seq.*, worked out with his usual accuracy and

* See also the Proc. Geol. Assoc., Pal. Biv. Entom., 1869, pp. 8, 11, &c., and the Monthly Microsc. Journ. vol. iv. 1870, p. 192.

† Ann. & Mag. Nat. Hist., Dec. 1865, pp. 415 &c.

‡ Monthly Microsc. Journ. *l. c.* pp. 189–191. See also M. Barrande's remarks to the same effect in his Système Silur. Bohême, vol. i. Suppl. 1872, p. 467.

§ This hard-working enthusiastic naturalist died January 20th, 1868, aged 51, much regretted by the members of the Natural-History Society of Mecklenburg, whose Journal he had edited for many years.

completeness. Lately Herr G. Reuter has given, in the Zeitschr. d. d. geol. Ges. vol. xxxvii. 1885, pp. 621 *et seq.*, a sketch of the history of the genus, with elaborate notes on its structural characters, on several of its species, their apparent genetic order, and their distribution in the Upper-Silurian rocks of Scandinavia, as indicated both by the Ostracoda found in the drifted blocks in North Germany and by those known in the parent strata.

The chief memoirs subsequent to those by Klöden (1834) and Jones (1855) treating of the Beyrichian limestones of Scandinavia in the Drift of Northern Europe are :—

1858. Ferd. Römer. Neues Jahrb. 1858, p. 270.
1859. Friedrich Schmidt. Archiv f. d. Naturk. Liv-, Ehst- und Kurlands, ser. 1, vol. ii. part 2, 1859, pp. 443, 445, 448, 453, 461–463.
1861. C. Grewingk. *Ibid.* part 3, 1861, pp. 571, 660, &c.
1862. Ferd. Römer. Zeitschr. d. d. geol. Ges. vol. xiv. 1862, p. 607.
1862. E. Boll. Archiv Ver. Fr. Nat. Meklenburg, 16. Jahrg. 1862, pp. 114 &c.
1869. G. Karsten. Beitr. Landeskund. Herzog. Schleswig und Holstein, ser. 1, part 1, 1869, pp. 1 &c.
1869. Heidenhain. Zeitschr. d. d. geol. Ges. vol. xxi. 1869, pp. 143–182.
1874. Feistmantel. Neues Vorkommen nord. Silur. Diluv. Lampersdorf, &c.
1877. A. Krause. Zeitschr. d. d. geol. Ges. vol. xxix. 1877, pp. 33–45 &c.
1878. K. Haupt. Neues Lausitzisches Magazin, vol. liv. 1878, p. 75.
1881. W. Dames. Zeitschr. d. d. geol. Ges. vol. xxxiii. 1881, pp. 434–441.
1884. J. Kiesow. Schriften der naturforschenden Gesellschaft in Danzig, new ser. vol. vi. part 1, 1884, pp. 205 &c.
1885. G. Reuter. Zeitschr. d. d. geol. Ges. vol. xxxvii. 1885, pp. 621–681.

Herr Reuter, like other observers, has been especially struck with the peculiarity of the extra large lobe present in many individuals among the Silurian *Beyrichiæ* towards one end of the ventral region of each valve. In the Proc. Geol. Assoc., Pal. Biv. Entom., 1869, p. 11, its cause was referred

to *advanced age*; but G. Reuter, following R. Richter *, thinks that the *eggs* may have lain within that lobe. A. Krause adopted this view hypothetically in his memoir (Z. d. d. g. G. vol. xxix. 1877, p. 32). They support their view by referring to Zenker's description † and figure of a right valve of a female *Cythere gibba*, with a distinct lobular swelling at the middle of the ventral border, rather bigger in its posterior than in its anterior moiety; its length is less than a third of that of the valve, and its width (height) is about one third of that of the valve.

Cytherura gibba (*Cythere*, Müller) is a well-known species, studied by Lilljeborg, Zenker, G. O. Sars, G. S. Brady, and D. Robertson. As with most of the Ostracoda, the female of *C. gibba* has a broader (that is, a more swollen) carapace than the male. In the genus *Cytherura* this thickness or lateral fullness is variable, and sometimes becomes strong and prominent, as in *C. Robertsoni* and *C. gibba*; but it is not localized as an isolated lump, as in Zenker's figure, which may be an accidental exaggeration, due possibly to malformation of the individual ‡. Certainly the female fullness of the carapace is strongest in the *posterior moiety* of the valves, in accordance with the *postero-dorsal* position of the ovaries in Ostracods and the Limnadiad Phyllopods, but for which a *postero-ventral* position would be quite abnormal, as intimated in the Proc. Geol. Assoc., Pal. Biv. Entom. p. 11. An analogue for the *postero-ventral* position of the ovaries might possibly be found by referring to the arrangement of the eggs in some Schizopods with their "brood-plates" or lateral supplementary laminar egg-covers; but this would be going too far from the simply bivalved Ostracods.

In the bivalved carapaces of recent Ostracoda the most compressed end is found to be the anterior, and in the majority of known forms this end is also the lowest (narrowest). This rule was adopted when it was necessary to refer by name to the extremities of the Beyrichian valves and their special lobes. These relative proportions in height (width) and thickness are observable in most of the *Beyrichiæ* excepting—(1) those which have naturally a semicircular ventral border, and (2) those in which the variable lobe

* Zeitschr. d. d. geol. Ges. vol. xxi. 1869, p. 774.

† "The female brings forth living young, and for their development the hinder body is enlarged by the two swellings" (Wiegmann's Archiv, 20. Jahrg. vol. i. 1854, p. 85, pl. v. D. fig. 2).

‡ In some *Leperditiæ* the margin of the right valve is *thickened* at the same place.

(regarded by us as *antero-ventral*, by Reuter as *postero-ventral*) has pushed out and overhung the margin, thus altering the shape of the valve. Take for instance the semicircular, fig. 14, pl. v. (Ann. & Mag. Nat. Hist. ser. 2, vol. xvi. 1855); and compare the regular figs. 5, 9, and 11, with the "big-lobed" figs. 7 and 8 on that plate. We cannot therefore adopt Mr. Reuter's cleverly devised nomenclature (*op. cit.* pp. 630, 631) for the fore and aft furrows of the Beyrichian valves, his "cephalic" and our "cephalic" being contradictory terms.

We have regarded the sulcus between the "sausage" and "middle" lobes as equivalent to the nuchal notch of Crustacea. Unfortunately there are no "ocular spots" in Beyrichian valves to give a clue to the *cephalic* extremity. In neither *B. oculina* nor *B. oculifera*, Hall, is there any satisfactory indication of this feature; nor has the exact position of the muscle-spot been determined. We may note that the Carboniferous, Devonian, and Lower-Silurian *Beyrichiæ* did not take on the exaggerated lobe, so far as we are aware.

Doubtless the alliances of the Leperditiadæ*, whether amongst themselves or with Ostracods on the one hand and Limnadiads on the other, are not yet well understood, as their soft parts are wanting; but, as all the living bivalved forms have the ovary in the *postero-dorsal* region, it would be too strange for this organ to be placed elsewhere in analogous fossil genera. It does not seem possible to allocate satisfactorily the internal organs to the external lobes; and until we have all the *Beyrichiæ* before us, in their great multiplicity and in their successional order, we cannot pretend to know all the features and their probable biological meanings †. With regard to the extraordinary outward growth of one lobe on each valve in *Beyrichia* it might possibly have reference to a fully-developed hepatic gland, if in this genus the liver had the same position that it has in *Cypris* according to Zenker (Archiv &c. 1854, vol. i. p. 37, pl. i. fig. 15). There is a possibility of its having had a parasitic origin, like the swelling caused by *Bopyrus* in the Prawn. The "big lobes" are not always quite equal nor quite opposite on the two sides in *Beyrichiæ*.

The protuberant and exaggerated antero-ventral lobe has

* Month. Microsc. Journ. 1870, pp. 187 &c.

† Some of the Cypridinadæ are smooth, but others have swellings of the valves, which seem difficult to collocate with internal organs. *Cypridella* is "swollen here and there into tubercles, fewer in the young than in the old state" (Monthly Microsc. Journ. vol. x. 1873, p. 74).

been figured or noted as present in individuals of the following species of *Beyrichia*:—

B. tuberculata (Klöden), Klöden, 1834, fig. 22; Jones, Ann. & Mag. Nat. Hist. ser. 2, vol. xvi. 1855, pl. v. figs. 7 *a*, 7 *b*, 8 *a*, and P. B. E. 1869, fig. 12 *c*; Boll, 1862, fig. 1 *a*; Karsten, 1869, pl. xx. figs. 3 *b* and *c*; Krause, 1877, pl. i. fig. 12 *b*.
B. Klædeni, M'Coy, Jones, Proc. Geol. Assoc. P. B. E. fig. 6 *b*; Heidenhain ("*tuberculata*"), 1869, pl. i. fig. 14.
B. protuberans, Boll, 1862, fig. 3; Karsten, 1869, pl. xx. fig. 3 *g*: *B. Klædeni-granulata*.
B. Klædeni, var. *granulata* (see further on).
—— ——, var. *nuda* (see further on).
—— ——, var. smooth and partially ridged: *B. cincta*, Boll, 1862, fig. 4.
—— ——, var. smooth: *B. lunata*, Kolmodin, 1869, p. 17, figs. 8, 9; referred by Kolmodin to *B. Klædeni* in 1880, p. 137.
—— ——, var. *intermedia*, Jones (see further on).
—— ——, var. *subtorosa*, Jones, P. B. E. fig. 10 *b*.
—— ——, var. *torosa*, Jones, *ibid.* fig. 11 *b*, and Ann. & Mag. Nat. Hist. 1855, xvi. pl. vi. fig. 11.
—— ——, var. *antiquata*, Jones, Ann. & Mag. Nat. Hist. 1855, xvi. pl. vi. fig. 12.
B. Buchiana, Jones, P. B. E. fig. 13 *b*.
—— ——, Jones, Krause, 1877, fig. 14 *b*.
B. Dalmaniana, Jones, Ann. & Mag. Nat. Hist. 1855, xvi. pl. v. fig. 13.
B. Salteriana, Jones, Krause, 1877, fig. 17 *b*.
—— ——, Jones, Kiesow ("*Maccoyana*," var.), 1864, pl. iv. fig. 6.
B. Maccoyiana *, Jones, Krause, 1877, fig. 16 *b*.
B. elegans, Boll, 1862, fig. 10 = *Salteriana*, Jones.
B. grandis, Kolmodin, 1880, pl. xix. fig. 8 *a*, *b* = ? *Salteriana*, Jones.
B. impendens, Jones, P. B. E. 1869, fig. 4 *b*.
B. Wilckensiana, Jones, Krause, 1877, fig. 18 *b*. The figs. 17, 18, 19 in pl. v. (Jones, *op. cit.* 1855) are correspondingly big-lobed individuals.

We may here mention that Dr. Krause suggests that *B. Dalmaniana*, Jones, is the same as *B. elegans*, Boll and that

* The German palæontologists prefer to write this word "*Maccoyana*;" and some uniformly misspell "*Wilckensiana*."

both are *big-lobed* ("female") forms of *B. Macooyiana*, Jones; but we cannot agree with him in this proposition. His suggestion that *B. protuberans*, Boll, is the *big-lobed* form of *B. Klœdeni*, M'Coy, is highly probable. We see the same condition in Heidenhain's pl. i. fig. 14, which is wrongly referred to *B. tuberculata*, as pointed out by Krause (*op. cit.* p. 32), who doubts, however, its being *B. Klœdeni*.

In his description of *B. grandis* (1880, p. 138), Dr. Kolmodin regards the big lobe there present as being *posterior*; but it may well be *antero-ventral*, as we have regarded it in other such forms. In *B. grandis* it bears on its middle a low process, hollowed out at the top like an oval-lipped hollow wart. This specimen and the one described and figured by Boll as *B. elegans* (1862, p. 135, fig. 10) are both imperfect (probably having been thin-shelled), and yet appear to have much in common—in their outlines, in the relative size and position of the central lobe, and in the oval outline of the exaggerated lobe, which is said to be neatly granulated in Kolmodin's, and cross-cut with striæ, bounding minute intermediate elevations, in Boll's specimen, the meshes longest with the long axis of the lobe. The exceptional size of the front lobe and the general granulation * of the surface make the chief differences.

The large collections of Ostracoda made of late years by Messrs. John Smith † and G. R. Vine ‡ from the Upper-Silurian § shales of Shropshire having been confided to us for description, we have had a good opportunity of extending our knowledge of the *Beyrichiæ*. Mr. C. D. Sherborn has effectively aided us in our work.

By careful working Mr. Vine in 1881 had picked out of the Upper-Silurian shales supplied by Mr. G. Maw, F.G.S. ‖, more than 60,000 specimens of the remains of Actinozoa, Echinodermata, Annelida, Polyzoa, Brachiopoda, Trilobita, and Entomostraca. Of the Polyzoa and Annelida he supplied descriptions in the Quart. Journ. Geol. Soc. vol. xxxviii. 1882, pp. 44 &c., and *ibid.* pp. 377 &c.; and lists of the others were given at the same time (see *ibid.* pp. 47–49).

His collection of the Entomostraca comprised many hundreds of specimens, and he commenced describing and

* It is difficult to determine under some microscopes whether we have granules or pits.

† Geol. Mag. dec. ii. vol. viii. 1881, pp. 70–75.

‡ Quart. Journ. Geol. Soc. vol. xxxviii. 1882, pp. 44 and 48.

§ "Upper Silurian" of Murchison and the Geological Survey, but "Silurian" of the Cambridge school of geologists.

‖ See the paper by Davidson and Maw, Geol. Mag. dec. ii. vol. viii. 1881, pp. 100–106.

cataloguing them. Their study and determination were, however, put aside for awhile; and ultimately Mr. Vine requested one of us to take the collection in hand for special treatment, liberally offering the whole for acceptance. The work of examining, comparing, describing, and illustrating this extensive and excellent series of Upper-Silurian Ostracoda, the more valuable on account of the known horizon of the bed from which each individual has been obtained, was undertaken with pleasure, but has necessarily occupied much time.

The coincident opportunity of critically examining another large and well-preserved series of Upper-Silurian Entomostraca was afforded by Mr. John Smith, of Kilwinning, kindly submitting for our determination and description the collection he had formed in 1880, and of which a provisional list was given by one of us in the 'Geological Magazine,' 1881, *loc. cit.*

Among the forms collected, as mentioned above, are the following genera:—*Beyrichia*, *Kirkbya*, *Primitia*, *Thlipsura*, *Æchmina*, *Cytherella*, *Cytherellina*, *Macrocypris*, and others; but on this occasion we can take only the *Beyrichiæ* into consideration.

With regard to Mr. Vine's collection, he informs us that the same numbers are connected with these specimens, to indicate the beds from which they came, as those used in his "Notes on Polyzoa" &c. (Quart. Journ. Geol. Soc. *loc. cit.*), and that he has found it "quite possible to speak of the relative abundance or the paucity of species in the different washings. From the five 'Buildwas' localities those marked no. 22 and no. 37 have yielded the greatest abundance of individuals; nos. 36 and 38, the richest beds for Polyzoa, have been very poor in their yield of Ostracoda. The Coalbrook-Dale washing (no. 43) is likewise poor. In the Tickwood beds, especially no. 25, and in Mr. Young's washing, no. 25*, the Ostracoda are abundant both in species and in individuals; and the same remark will apply to the 'Shales over the Wenlock Limestone,' no. 46."

The order of the beds and the numbers of the boxes of washed material, as adopted by Davidson and Vine, are:—

"Shales over the Wenlock Limestone, 24 and 46.

"The Wenlock Limestone, not examined.

"Upper Wenlock Shales, 25, 25*, 41, 42. Tickwood beds.

"Middle Wenlock Shales, 43. Coalbrook-Dale beds.

"Lower Wenlock Shales, 22, 36, 37, 38, 40. Buildwas beds."

Mr. Vine has already drawn attention to the fact that much

of the finer débris of the shales must have been lost in the washing †, and the small Entomostraca must have escaped with it; but there was some unwashed clay in the cases sent to him, and from this and in cleaning the other fossils he was able to collect a fair sample of the shale. This he carefully manipulated, and out of the several fresh washings he collected more than three thousand specimens of Entomostraca. Altogether there are between forty and fifty species and notable varieties. Individuals of some of these are rare and local; others are common. The most abundant of the whole are those usually referred to smooth *Cytheræ* and *Thlipsuræ*; *Beyrichiæ* are also common.

Mr. John Young, F.G.S., of the Hunterian Museum, Glasgow, received from Mr. Maw a packet of shale weighing about ten pounds from the Tickwood beds and another of about the same weight from the Buildwas beds. The clay from the Tickwood beds he carefully washed; and in a letter to Mr. Vine (dated June 12, 1880) he gives the following particulars:—"I weighed five pounds of the dried shale and put it in water until it was thoroughly dissolved, stirred it gently with the hand, poured the muddy water off, and kept on washing until the water remained quite clear. When the residue was dried, I found that out of five pounds weight only two and a half ounces remained. This was composed of fragments of still unwashed shale, a number of specimens of small Brachiopods, fragments of Polyzoa, some of Trilobites, a species of *Conchicolites*, a number of Entomostraca, and fragments of other organisms." This gathering is marked 25* in the list, the organisms generally agreeing with those found in no. 25.

I. Beyrichia, M'Coy, 1846.

Beyrichia, M'Coy, Silur. Foss. Ireland, 1846, p. 58.
Beyrichia, Boll, Dunker und von Meyer's Palæontogr. vol. i. July 1847, p. 127.
Beyrichia, auctorum.

This genus is known by small, semicircular, semi-ovate, and more or less oblong valves, strongly lobed by deep transverse furrows. The amount and extent of sulcation vary very much. Some unisulcate allies, formerly termed *Beyrichiæ simplices* (already alluded to), of simple outline, and passing into small, feebly furrowed, or non-sulcate Leperditioid forms, have been separated as *Primitiæ*. The *Beyrichiæ* proper (*Jugosæ*) have the surface of the valves impressed with

† *Op. cit.* p. 44.

two strong vertical furrows, extending from the back to the ventral portion of the valve and dividing the surface into three unsymmetrical lobes, transverse ridges, or bosses. These vary considerably in size, mode of subdivision, and relative position in different species and their varieties, and to some extent in different stages of individual growth. The hinder and usually larger lobe is somewhat leg-of-mutton- or gigot-shaped; hence it may be termed the "gigot-lobe." It is often transversely sulcate. The lobe at the other end may be called the "sausage-lobe," whether entire or constricted. Its distended ventral extremity, making the extraordinary "big lobe," is subglobular or apple-like. The middle lobe is usually egg-shaped, but may be narrow and elongate. The gigot and middle lobes are usually connected below, but sometimes this condition is obscure; and in some specimens the ventral portions of all three lobes are almost equally united.

The ventral and two end margins of each valve are turned sharply inwards, the angle so made being marked externally by a prominent rim or ledge, slightly rounded or trenchant, along these three edges of the valve. An additional frill-like free flange sometimes (in adults) stands out along the ventral region * above the border. These thin laminar processes, as well as the real marginal flange, are divergent, so as to give a broad basis to the carapace standing on its ventral surface. They are also sometimes frilled (crimped or goffered) with radiate striæ; sometimes they have a spiny fringe, and frequently present only denticles or short blunt spines. The surface of the valves may be minutely pitted or coarsely reticulate; and frequently small granulations, passing into tubercles, ornament the whole or part of the valves; and the large exaggerated antero-ventral lobe occasionally shows an elegantly delicate reticulate surface. The dorsal edges of the two valves meet along the hinge-line without any special modification. The other contact-edges close together by the marginal flange of the one valve being received by the edge of the other. The valves are almost equal in size, the ventral edge of the left valve very slightly overlapping that of the right.

Some special *Beyrichiæ*, typified by *B. Wilckensiana* and its variety *plicata*, constitute the group *Corrugatæ*†.

* This supernumerary flange is also met with in some Carboniferous *Beyrichiæ* and *Kirkbyæ*.

† Ann. & Mag. Nat. Hist. ser. 2, vol. xvi. pp. 89–90, 175, and vol. xvii. p. 83, footnote. We now omit *B. Ribeiriana*, *B. affinis*, and *B. Barrandiana* (*op. cit.* pp. 170, 171) from the *Corrugatæ*.

They have smooth convex valves, impressed with two short vertical furrows on the dorsal region; and in the type a third smaller furrow defines a narrow semilune at the front end of the valve. Two such small, vertical, parallel furrows characterize the variety *plicata*. *B. Wilckensiana* differs so much in general features from typical *Beyrichiæ* that we think this purse-like form ought to be raised to generic distinction as KLŒDENIA, a name we propose to use in honour of Karl Friedrich von Klöden, who first noticed the *Beyrichiæ*.

The furrows in *Klœdenia* do not alter the contours of the valves so much as the deeper and broader four sulci in *B. bussacensis*, Jones (Proc. Geol. Assoc., Pal. Biv. Entom. 1869, p. 15, fig. 23), and we may add perhaps *B. Forbesii*, Jones (*ibid.* fig. 19). This or a similar arrangement of parts may hold good according to the description (not accompanied by a figure) in Billings's *B. decora* (Sil. Foss. Anticosti, 1866, p. 66). Another possible ally is *B. persulcata*, Ulrich, from the Hudson-River Group (Journ. Cincin. Soc. N. H. vol. ii. 1879, p. 4, pl. vii. fig. 6). *B. pennsylvanica*, Jones (Ann. & Mag. Nat. Hist. ser. 3, vol. ii. pp. 252, 253, pl. x. figs. 15–18), also possesses four lobes or ridges in its adult form*. *B. nana*, Brögger (Die silurischen Etagen 2. und 3. im Kristianiagebiet und auf Eker, 1882, p. 55, pl. xii. fig. 15), is also one of the four-lobed *Beyrichiæ*. These *Beyrichiæ* having more than three transverse lobes on their valves may be grouped as *Plurijugatæ*. Our new species *Beyrichia admixta* (see further on) is one of this group, and *B. lacunata*, sp. nov., is not far removed from it.

1. *Beyrichia tuberculata* (Klöden).

Battus tuberculatus, Klöden (pars), 1834, Verstein. Mark Brandenburg, pp. 115–117, pl. i. figs. 21–23.

Beyrichia tuberculata, Boll, 1847, Palæontogr. vol. i. p. 127, 1862, Archiv Vereins Freunde Naturg. Meklenburg, 16. Jahr. p. 119, pl. O, figs. 1 *a*, *b*; var. = *B. Kochii*, Boll, *l. c.* p. 121, fig. 2 (? = var. *nuda*, Jones).

Beyrichia tuberculata, Jones, 1855, Ann. & Mag. Nat. Hist. ser. 2, vol. xvi. p. 86, pl. v. figs. 4–9 *b*; Proc. Geol. Assoc., Pal. Biv. Entom. 1869, p. 12, figs. 12 *a*, *b*, *c*; Geol. Mag. dec. ii. vol. iii. 1881, p. 344, pl. x. figs. 8, 9, 10.

Beyrichia tuberculata, var. ***nuda***, Jones, 1855, *op. cit.* figs. 10, 11, et var. ***antiquata***, fig. 12.

Beyrichia tuberculata, Karsten, 1869, Beiträge zur Landeskunde d.

* The frilled specimens of this species (fig. 15) were wrongly referred to *B. Maccoyiana* (*loc. cit.*).

Herzog. Schleswig und Holstein, series 1, part 1, p. 57, pl. xx. figs. 3 *a*, *b*, *c*.
Beyrichia tuberculata, Krause, 1877, Zeitschr. d. d. geol. Ges. vol. xxix. p. 30, pl. i. figs. 12 *a*, *b*, and var. fig. 13.
Beyrichia tuberculata, var. *gedanensis*, Kiesow, 1884, Schr. naturf. Ges. Danzig, new ser. vol. vi. p. 277, pl. iv. fig. 5.
Beyrichia tuberculata, Reuter, 1885, Zeitschr. d. d. geol. Ges. vol. xxxvii. p. 632, pl. xxv. figs. 1 A and B [and the varieties figs. 2–9].

B. tuberculata (Klöden) is characterized by the nearly oblong shape and the strong growth of its valves, their well-defined margins, and their three full lobes. The front lobe is sausage-shaped, sometimes single, but usually constricted or cut crosswise, so as to be divided into two unequal lobes. The midlobe is single, oval, and usually free, but occasionally united by a low and narrow isthmus with the foot of the posterior lobe. The last is the largest, somewhat semilunar or curvi-pyriform (gigot-shaped), and more or less tripartite, rarely (in some varieties) less strongly sulcate; but in some cases it is resolved into several isolated tubercles. The surface, especially of the large lobes, is coarsely and irregularly granulate, and the margin also is sometimes tuberculate.

The late Dr. Ernst Boll objected that Klöden should be the "authority" for this species, because the latter included all his figures in *Battus tuberculatus*. As, however, he regarded some as immature forms, the figs. 21, 22, and 23 still remain as representing the typical species. His figs. 16 and 17 are *B. Wilckensiana*, Jones (fig. 16 being var. *plicata*, not *Cytherellina siliqua*, as Krause thinks). Fig. 18 is probably *B. Salteriana*, Jones, as suggested by Krause; and fig. 19 may be the *B. Bolliana* of Reuter, but cannot be *B. complicata*, as supposed by Boll; nor (together with fig. 18) does it represent *B. Wilckensiana*, as supposed by Jones in the Ann. & Mag. Nat. Hist. for August 1855, p. 87.

Dr. Boll recognized that his *B. Kochii*, described as being smooth, is like Jones's fig. 5, pl. v., 1855, which, however, is granulated, and may stand as a weak form of *B. tuberculata* (Klöden). *B. Kochii* still more closely agrees with figs. 10 and 11 of that plate; and the latter individuals, so illustrated, might be called *B. Kochii*, Boll, if the absence of ornament were a specific character in this and the analogous case of *B. Klœdeni*, var. *nuda*, Jones (fig. 7, pl. vi., September 1855). So also Dr. Boll was disinclined to include Jones's fig. 12, pl. v. (var. *antiquata*), in the species *B. tuberculata*, the posterior (gigot) lobe being weakly developed; but an analogous varietal form accompanies the typical *B. Klœdeni* (see pl. vi. Sept. 1855, fig. 8, and Geol. Mag. 1881, p. 345, pl. x. fig. 11);

it is noticed also by Kolmodin (Œfvers. K. Vet.-Akad. Förhandl. for 1879, vol. xxxvi. 1880, p. 137.

We must remember that by themselves neither the splitting-up of the lobes nor the granulation of the surface can be taken as specific characters, so many instances of the capricious adoption of these features being known.

(1) *Beyrichia tuberculata*, var. *gibbosa*, Reuter.
(Pl. XII. figs. 1 *a*, 1 *b*.)

Proportions*:—Length 27. Height 16. Thickness 18.

In one specimen, seeming to belong at first sight to the varietal group of *B. Klœdeni-torosa* (see further on), the subdivision of the gigot-lobe has proceeded a step further, and there are *three* lobules, thus presenting a leading character of *B. tuberculata*, Klöden. The other lobe is distended ventrally. This individual is scarcely to be distinguished from the variety figured and described by G. Reuter as *B. tuberculata-gibbosa* (Z. d. d. g. G. 1885, p. 634, pl. xxv. fig. 2 B). Krause's fig. 12 *b*, pl. i. (Z. d. d. g. G. 1877, p. 30), *B. tuberculata*, is very similar.

This specimen (on slide no. 9 of Mr. J. Smith's collection) is from the Upper-Silurian beds at Dudley Castle.

The same collection has a modification of *B. Klœdeni*, var. *subtorosa*, which imitates a variety of *B. tuberculata* (see p. 353, under var. *subtorosa*).

2. *Beyrichia Klœdeni*, M'Coy, 1846.

Some observations on this variable species, as to its history, character, and synonyms, were offered by one of us in the Ann. & Mag. Nat. Hist. ser. 2, vol. xvi. 1855, pp. 166 *et seq.*, and in the Geol. Mag. dec. ii. vol. viii. 1881, p. 345.

The typical form is characterized by the nearly semicircular or ovate-oblong shape of the valves and their three neat lobes. The front and hind lobes are large, nearly equal, pyriform and curved; and the hind lobe turns up sharply from below towards, and often joining, the smaller oval midlobe. The surface may be granulate or smooth, and the ventral margin more or less developed. Sometimes the anterior and the posterior lobe each turn towards and meet the midlobe, with distinct necks of junction; and, when so connected, all become more or less attenuate and straight (vars. *intermedia*, *pauperata*). Sometimes the front and hind lobes run together below, leaving the midlobe distinct and either free or lying against the inner side of one of the other lobes (var. *tuberculata*). On the other hand the front and hind lobes become

* If divided by 15, these will give the measurements in millimetres and parts of a millimetre.

constricted or bipartite, and even divided into distinct lobes (vars. *torosa*, *subtorosa*). In one instance, whether a variety or a species is doubtful (fig. 12, pl. vi. Ann. & Mag. Nat. Hist. 1855, vol. xvi.), the front lobe is tripartite and the hind lobe (obscure in the specimen) seems to be undivided. It is difficult in very many cases to determine where varietal changes end and specific distinctions take their stand.

Beyrichia Klœdeni, M'Coy, is subject to considerable variation in the relative shape and proportions of its lobes, ridges, and furrows, besides being affected by a subdivision of the lobes, as in the varieties *subtorosa* and *torosa*. In the narrowness of the lobes and width of the furrows the varieties *intermedia* and *pauperata* are conspicuous. In the latter the furrows are very much widened at the expense of the ridges, which are not only narrow but much attenuated below, a thin line only partially connecting the front and hind lobes along the ventral margin, while the middle lobe is greatly reduced, comma-like, and isolated. This form accompanies var. *torosa* in the Upper-Ludlow rock of Aymestry Common (both as casts), and is figured in the Pal. Biv. Entom., Proc. Geol. Assoc. 1869, p. 14, fig. 8.

Several British varieties are noticed (with references) in the Geol. Mag. (*l. c.*) as being marked by the relative development of the three lobes, ranging from the variety *pauperata*, having very narrow lobes, and the var. *torosa*, with its subdivided lobes, to the typical *Klœdeni*, with well-developed neatly-shaped lobes, and its var. *tuberculata*, in which the lobes take up a large portion of the valves, and, leaving the middle lobe more or less distinct, have become almost or quite confluent below. A general tuberculation of the surface is common in the last variety and is present also in some others. In the collections made by Messrs. Smith and Vine we meet with some of the varieties here alluded to, and with intermediate conditions, whether of individual growth or of progressive development. As *B. Klœdeni* varies in two directions (in one set of individuals the lobes becoming narrower and wider apart, and in the other becoming thick and closer), it is difficult to take all its varieties in one order. We first take the typical forms, and then those showing attenuation of the lobes.

I. *Lobes free and plump.*

(1) *Beyrichia Klœdeni*, var. *granulata*, Jones.
(Pl. XII. fig. 2.)

Proportions:—L. 18. H. 11.

The common three-lobed *Beyrichia* somewhat granulated

(Ann. & Mag. Nat. Hist. Sept. 1855, vol. xvi. p. 166, pl. vi. fig. 9). The hinder lobe is not divided nor constricted; but with age both the hind and front lobe generally bear one or more tubercles on their prominent dorsal ends. This is the "granulated variety" referred to in the Geol. Mag. 1881, pp. 345 and 346. The older individuals in some cases pass into var. *tuberculata*, Salter.

The front lobe is greatly enlarged ventrally in some specimens. This condition occurs in individuals of several distinct species (Upper-Silurian, see above, p. 342) as well as varieties; and therefore it is not a specific character, as Boll thought it was when he described and named a form similar to the above as *B. protuberans*. What organ of the animal took on an increased structure, so as to cause the valves to be thus locally swollen in the antero-ventral region, we do not know. The *ovaries* in living Ostracoda and Limnadiads are situated in the postero-dorsal region (see above, p. 340).

B. Klœdeni-granulata, Smith Coll. no. $9_{1,2,5}$, from Dudley Castle; no. 10, railway-cutting, side of the Severn, Ironbridge; no. 21, railway-cutting, Coalbrook Dale. All with the "big lobe."

Vine Coll. LXVI$_9$, from the Tickwood Beds; XXXIX, passing into var. *tuberculata*, Salter, from bed no. 46. All big-lobed.

(2) *Beyrichia Klœdeni*, var. *nuda*, Jones.

This is the *B. Klœdeni* with a "smooth valve," referred to in the Geol. Mag. 1881, p. 345; see also Ann. & Mag. Nat. Hist. Sept. 1855, vol. xvi. p. 166, pl. vi. fig. 7. A smooth variety of the typical *B. Klœdeni*, but larger than the figured specimen above alluded to, and with the exaggerated antero-ventral lobe, occurred in Mr. G. R. Vine's collection, from the Wenlock Shales, no. 46, but has been lost. In Mr. J. Smith's collection (no. 24 slide) is a large smooth *B. Klœdeni*, or, at least, one with the granulation reduced to a minimum. This is from the Wren's Nest, Dudley. In Mr. Vine's collection (slide no. LXVI) is a large *B. Klœdeni*, quite smooth, from the Tickwood Beds.

The large individuals of each variety put on strong marginal edges and exaggerate their lobes dorsally into apical bosses or projecting tips.

(3) *Beyrichia Klœdeni*, var. *antiquata*, Jones.

Beyrichia Klœdeni, var. *antiquata*, Jones, Ann. & Mag. Nat. Hist. Sept. 1855, vol. xvi. p. 167, pl. vi. fig. 8.

This is referred to above (page 348). *B. Klœdeni*, var. *granulata* (some big-lobed), passing into var. *tuberculata*, Salter, together with var. *antiquata*, have been found in Upper-Silurian shales near Muirkirk and Lesmahago, Lanarkshire.

II. *Lobes less free, attenuated.*

(4) *Beyrichia Klœdeni*, var. *intermedia*, Jones.
(Pl. XII. figs. 3 and 4.)

Proportions:—Fig. 3 (*subspissa*): L. 21. H. 14. Th. 10.
Fig. 4: L. 14. H. 8.

This variety was distinguished and figured in the paper on "Palæozoic Bivalved Entomostraca" in the Proc. Geol. Assoc. 1869, pp. 12 and 14, fig. 9.

Valves suboblong or nearly semicircular, with raised marginal rim and three nearly equal lobes, relatively narrow and vertical, the middle lobe not being short-oval, but reaching down into the ventral region and coalescing freely with the lower ends of the other two lobes. An approximation to this feature is evident in some specimens collected by Mr. Smith from "Woolhope" and by Mr. Vine from the "Tickwood Beds" and the "Shales over the Wenlock Limestone." In the latter, however, the lobes are somewhat thicker than in the specimens from the Upper-Ludlow shales.

In Mr. Vine's examples the surface is punctate or slightly reticulate, but usually roughened. No two have exactly the same outline and contours of lobes and margins. Some are more semicircular than others, and some have the lobes thicker and with less interspaces than others (fig. 3 *a*, *b*). This last modification might be termed subvariety *subspissa*. A raised marginal rim is distinct in all. This form is near to and corresponds with the North-American *B. lata* (Vanuxem, Ann. & Mag. Nat. Hist. ser. 2, vol. xvi. p. 168, pl. vi. fig. 13).

Var. *intermedia* presents a more complete union of the posterior and the central lobe in a horseshoe-shaped ridge than is found in the typical form of *B. Klœdeni*, and herein resembles *B. Buchiana*. The front lobe also is connected with the middle lobe by a depressed neck, a condition observable in *B. Buchiana* and some others. Besides the greater distinctness of the lobes in *B. Buchiana*, the notching or tendency to subdivision in its posterior lobe separates it from the variety of *B. Klœdeni* under notice, which was designated as

intermedia in 1869 from specimens found by Mr. Banks near Kington in company with the typical *B. Klædeni* and its var. *torosa* (all in the state of casts).

No. 12 in Mr. Smith's collection, from the railway-cutting near Much-Wenlock, is a good example of this variety, and has the exaggerated antero-ventral lobe.

Smith Coll. no. 12 (with "big lobe"). Railway-cutting near Much-Wenlock.
55₄. Woolhope. (Fig. 4.)
Vine Coll. no. XLIV₁. Bed no. 46. (Fig. 3.)
XLIX₃. Bed no. 25.

III. *Lobes free and subdivided.*

(5) *Beyrichia Klædeni*, var. *subtorosa*, Jones.
(Pl. XII. figs. 6 and 7.)

Proportions :—L. 18. H. 12.

This is a rather small semicircular form which has a distinct, raised, sharp, continuous marginal rim within the curved border, and the three usual lobes rather narrower than in the typical *B. Klædeni*. The hinder or gigot-lobe is variously modified by a slight sulcation, either transverse, oblique (fig. 6), or nearly vertical, sometimes double (fig. 7). These marks are not often sharply defined. In some respects it much resembles *B. Klædeni*, var. *nuda* (see above, p. 351); but the lower end of each of the outer lobes curves up more definitely towards the median lobe, and the gigot is sulcated.

In the relative narrowness of the lobes this variety approaches var. *intermedia*, Jones, above mentioned, and more closely those individuals with the thicker lobes; but the very symmetrical form and the sulcate gigot-lobe connect it with the already-published variety *subtorosa*. This is near *B. Buchiana* (Ann. & Mag. Nat. Hist. 1855, vol. xvi. p. 86, pl. v. figs. 1–3; and Proc. Geol. Assoc., Pal. Biv. Ent. 1869, p. 12, fig. 13), but the valves are not oblong (except in some cases with the exaggerated lobe) and the outer lobes are much more curved (like the terminal margins), and not almost vertically straight, as in var. *intermedia* and *B. Buchiana*.

In Mr. Smith's collection is a specimen (no. 34 slide) with *two* weak parallel oblique furrows on the gigot-lobe (fig. 7), thus imitating, if not actually becoming, *B. Kochii*, Boll (*op. cit.* 1862, fig. 2), which is the same apparently as *B. tuberculata*, var. *nuda*, Jones (*op. cit.* 1855, pl. v. fig. 10, see above, p. 348). This is another of those linkings between Upper-Silurian *Beyrichiæ* which would almost persuade us to group

the majority in one species, were it not that in all probability the several animals varied in their soft parts and limbs.

B. Klœdeni-subtorosa is in the Smith Collection—no 17, from Blue Holes, Rushal Canal, Walsall; no. 31, railway-cutting, side of Severn, Ironbridge; no. 32, Stoke-Saye, Craven Arms; no. 34, Woolhope (fig. 7). In the Vine Coll. no. XLVI (fig. 6) and no. LXVI, Tickwood Beds.

(6) *Beyrichia Klœdeni*, var. *torosa*, Jones.

Beyrichia Klœdeni, var. *torosa*, Jones, Ann. & Mag. Nat. Hist. Sept. 1855, pl. vi. figs. 10 and 11, and fig. 12?

Valves subquadrate, with two of the usual three lobes broken up each in two smaller lobes.

A specimen with a "big lobe," in Mr. Smith's collection (slide no. 9), from Dudley Castle, has the gigot-lobe divided into three lobules (figs. 1 *a*, 1 *b*), and thus closely imitates, if it does not identify itself with, a variety of *B. tuberculata*. See above, p. 349.

IV. *Lobes coalescing below.*

(7) *Beyrichia Klœdeni*, var. *tuberculata*, Salter. (Pl. XII. figs. 8 *a*, *b*, 9 *a*, *b*.)

Proportions:—Fig. 8: L. 35. H. 30.—Fig. 9: L 22. H. 12. Th. 9.

Beyrichia Klœdeni, var. *tuberculata*, Salter, Geol. Mag. dec. ii. vol. viii. 1881, pp. 345, 346 (for synonyms, &c.).

We have remarked above (p. 351) that old individuals of the granulate *B. Klœdeni* have the roots of their lobes so much thickened that they nearly coalesce, as in the variety before us. The extremes seem at first sight to be quite distinct, but sufficient gradations to connect them are met with.

1. In var. *tuberculata* the front and hind lobes are not at all separated; that is, they do not thin away and become constricted below, but are broadly confluent in the ventral region. The surface bears small tubercles, and in some cases a minute interstitial pitting is also present (Smith Coll. no. 18, Woolhope; figs. 8 *a*, *b*). It sometimes has the exaggerated or hypertrophied lobe, and is then almost undistinguishable from an old big-lobed *B. Klœdeni-granulata.*

These specimens are coarsely granulated and at the dorsal ends of the lobes bear one or more tubercles or small knobs.

2. Mr. Vine's XXXVIII (bed no. 25) similar, but not quite so coarsely granulose. The internal cast shows a deeper sulcus than is seen on the valve.

3. Mr. Vine's XLI (bed no. 25), not differing from the foregoing except being larger and smoother, that is, much less coarsely granulated. Front and hind lobes fully confluent.

This variety retains its leading characters among numerous specimens in the Upper-Silurian shales, though the tuberculation varies in intensity. Mr. Smith's no. 15 (Severn, Ironbridge) has one specimen with a subdentate edge, as also in fig. 8 *a*. Occasionally individuals have the "big lobe."

A fine old individual of var. *tuberculata*, Salter (not *B. tuberculata*, Klöden), is in Mr. John Smith's collection (no. 19), from a yellowish shale in a roadside quarry at Gleedon Hill, between Buildwas and Much-Wenlock (see Geol. Mag. Feb. 1881, pp. 72 and 74). It was associated with numerous small Brachiopods and Crinoids, some Polyzoa, Conodonts, and minute pearl-like bodies, such as those described and elucidated by Prof. Sollas (Quart. Journ. Geol. Soc. vol. xxxv. 1879, p. 501, pl. xxiv. figs. 12, 17–20). For similar little pearl-like fossils see C. Barrois's 'Terrains anciens des Asturies et de la Galice,' 1882, p. 45, pl. xx. fig. 4 (uppermost figures), there referred to coccoliths.

Smith Coll. no. 15. Railway-cutting, side of Severn, Ironbridge.
18. Woolhope (figs. 8 *a*, *b*).
19, with big lobe. Gleedon Hill, Much-Wenlock.
23. Benthall Edge.
24, rather variable as to tubercles and mid-lobes. Wren's Nest, Dudley.

Vine Coll. no. XXXVIII. Bed no. 25: and subvar. *clausa*.
XL. Beds nos. 22 and 46.
XLI. Bed no. 25.
LXI. Coarse. Bed no. 46.
XLIV_{11}. Bed no. 22.
LXV_{8}, with big lobe; $_{9}$ and $_{10}$ granulate and one *B. Kl.-nuda*. Bed no. 46.
$\text{LXVI}_{8,\,9}$. Smoothish and granulate. Bed no. 25.

Subvariety *clausa*, nov. (Fig. 9.)

Mr. Vine's no. XLVII, from the bed no. 46, exhibits a weak condition of the variety *tuberculata* (Salter), similar to that shown by the small specimen (a cast) from the Upper Llandovery of Howler's Heath, near Malvern, figured in the Geol. Mag. decade ii. vol. viii. 1881, p. 345, pl. x. fig. 12, and belonging to this subgroup, in which the hind

and front lobes take up a large portion of the surface, leaving the middle lobe small, but distinct, in a subcentral depression. Ventral margin slightly developed. The surface bears small scattered tubercles, as in Salter's fig. 14 *a*, from which it slightly differs in shape, being longer in proportion. Edge view narrow-oval.

In shape and the position of the middle lobe, this form has some resemblance to *B. impendens*, Jones*, but it is sufficiently distinct in several respects.

In the "Shales over the Wenlock Limestone," no. 46. This small subvar. of *tuberculata*, Salter, has a "very limited range in the Shales" (Vine).

(8) *Beyrichia Klœdeni*, var. *scotica*, nov.
(Pl. XII. fig. 10.)

Proportions:—L. 12. H. 9.

A closely allied form comes from the Middle-Silurian (Llandovery) rocks near Girvan, Ayrshire. It is shorter, being more nearly semicircular; the middle lobe is rather more definitely egg-shaped, and there is a thick raised marginal rim in all. A *smooth subvariety* was described and figured as *B. Klœdeni* by one of us in the 'Monograph of the Silurian Fossils of the Girvan District,' by Nicholson and Etheridge, Jun., 1880, p. 218, pl. xv. figs. 8–8 *b*†; and of the present strongly granulate form (fig. 10) we have seen four imperfect specimens (in Mrs. Gray's collection) from Bargany-Pond Burn. Of these, one small hollow cast, preserving the best proportion of characters, is here figured; but the midlobe is higher up than in older individuals. Excepting this lobe the surface bears large scattered granules, sometimes concentrically arranged, and the raised margin has a distinct row of them also. The specimens occur in a hard limestone and have not been got out free of matrix.

3. *Beyrichia concinna*, sp. nov.
(Pl. XII. figs. 22 *a*, *b*.)

Proportions:—L. 10. H. 5. Th. 5.

This little unique carapace is very neat, compact, and semiovate, deeply impressed in the dorsal region of each valve with two short and unequal sulci, marking off a short and distinct midlobe. This is continuous with the general con-

* See Nicholson and Etheridge's 'Monograph Silur. Foss. Girvan, vol. i. 1880, p. 210 (references, &c.).

† We may here mention that a few other *Beyrichiæ* and *Primitiæ* from Girvan remain to be described.

vexity of the valve, and lies closely against one of the main lobes, which are quite confluent below. The surface of the valves is delicately reticulate, the marginal rim is distinct and uniform. The edge view is sharp-ovate, notched at the sides not quite symmetrically.

This rare form (no. 29 of Mr. J. Smith's collection) is from Dormington, near Stoke-Edith. It is apparently related to the subvariety *clausa* (fig. 9), but its reticulate ornament and other features sufficiently distinguish it.

4. *Beyrichia Maccoyiana*, Jones.
(Pl. XII. figs. 11 *a*, *b*, *c*, 12, 13 *a*, *b*.)

Beyrichia Maccoyiana, Jones, Ann. & Mag Nat Hist. ser. 2, vol. xvi. 1855, p. 88, pl v. fig. 14. (Not *B. Maccoyiana*, Jones, *ibid.* ser. 3, vol. i 1858, p. 252, pl x. fig 15, which is *B. pennsylvanica*, *ibid.* p 253, retaining the marginal frills absent in figs. 16–18)

Beyrichia Maccoyana, Boll, 1862, Archiv Ver. Freunde Naturg. Meklenburg, 16 Jahrg. p 134, pl. O fig. 9.

Beyrichia hians (?), Boll, 1856, Zeitschr d. d. geol. Ges. vol. viii. p. 323, fig. 4; and 1862, Archiv &c. p. 136, pl. O. fig. 11.

Beyrichia Maccoyana, Heidenhain, 1869, Zeitschr. d. d. geol. Ges. vol. xxi p. 171, pl. i fig. 13.

Beyrichia Maccoyana, Krause, 1877, Zeitschr. d. d. geol Ges vol. xxix. p. 34, pl i. fig 16 *a*, *b*.

[We are not inclined to admit as synonyms *B. Dalmaniana*, Jones, and *B elegans*, Boll, as suggested by Dr A Krause, *op. cit* pp 34, 35]

Beyrichia Maccoyana, Kolmodin, 1879, Œfvers. K. Vetensk.-Akad. Fordhandl vol. xxxvi. p. 138 (not all the synonyms)

Beyrichia Maccoyana, et varr., Reuter, 1885, Zeitschr. d. d. geol. Ges. vol. xxxvii. p. 643, pl. xxvi. figs. 16–18 *c*.

Proportions:	Fig. 11:	L. 22.	H. 15.	Th. 14.
	Fig. 12:	L. 19.	H. 12.	
	Fig. 13:	L. 22.	H. 16.	

Several specimens, from the Upper-Silurian Shales, in Messrs. Smith's and Vine's collections, are sufficiently similar in character and features to allow us to refer them to this Scandinavian species. In these English examples the hinder lobe is large and pyriform, uniting below by a definite curve with the middle lobe, and the anterior lobe, also pyriform but smaller, comes down and touches their connecting isthmus. The "middle" lobe is occasionally somewhat excentric (fig. 12).

The surface is punctate, but more often reticulate, like the impressions on the head of a thimble, but much more delicate. The radiate marginal fringe or frill is more distinct in some individuals than in others, and this in adults is really not the margin itself but a free flap spreading outwards from the valve above it. It is often unequal in breadth in its semicircular extension, and projects outwards and downwards,

giving a broad ovate outline to the ventral surface of the closed and perfect carapace (fig. 11 *c*), which has the real marginal rims besides.

In some smaller specimens (XLII, said to be of "very local" occurrence by Mr. Vine) the margin is narrower and simple, and the front and hind lobes are confluent below.

Taking the varieties together, the width of the free margin and the ventral confluence of the lobes are variable, being different in individuals. In fig. 12 (Mr. Smith's no. 22) the front and middle lobes are closer together than usual, and the flange has not put on the crimped or goffered pattern.

In fig. 13 *a* the hypertrophy of the anterior lobe (which is not very common in this species) has misshaped the valve and encroached greatly on the frilled border. The reticulation on the valve is irregular, but on the "big lobe" it is small, neat, and elegantly regular (fig. 13 *b*).

E. Boll figured and described some *Beyrichiæ* of this alliance in the Zeitschr. d. deutsch. geol. Ges. vol. viii. 1856, pp. 321 and 324, as *B. Jonesii*, Boll, figs. 1 and 2; *B. spinulosa* (*nodulosa*, Boll, 1862), fig. 3; and *B. hians*, Boll, fig. 4, from the drifted blocks of Upper-Silurian limestone found in North Germany. In 1862, 'Archiv Ver. Freunde Natur. Meklenburg,' 16. Jahrg. pp. 133, 134, *B. spinigera*, Boll, fig. 7, and *B. Maccoyana*, Jones, fig. 9, were added from the same source.

The margin is tubercled in *B. nodulosa*, and marked with prickles in *B. spinigera*; but in the other three the marginal frill is radiately striate, with some variations in pattern and intensity. The lobes differ in their proportions in all. *B. hians* is so called because in the described valve (unique?) the antero-ventral edge is, as it were, pressed inward and upward (projecting at one spot obliquely outward), so that the carapace gaped there when the valves were closed, if the notch be a real feature and not the result of local accident.

Smith's no. 13, small. Railway-cutting, Much-Wenlock.
14. Railway-cutting, Coalbrook Dale.
17. Blue Holes, Rushal Canal, Walsall.
20. Railway cutting, Coalbrook Dale.
22. Lincoln Hill, Ironbridge.
25 (fig. 13 *a*, *b*), with "big lobe." Railway-cutting, side of Severn, Ironbridge.
27. Railway-cutting, side of Severn, Ironbridge.
28. Railway-cutting, side of Severn, Ironbridge.

Vine's no. XLII. }
XLIII$_1$. (fig. 11). } Tickwood Beds.
LXVI. }

5. *Beyrichia Jonesii*, Boll.

Beyrichia Jonesii, E. Boll, 1856, Zeitschr. d. d. geol. Ges. vol. viii. p. 322, figs. 1 and 2,; 1862, Archiv Ver. Fr. Nat. Meklenburg, 16. Jahr. p. 134, fig. 8.

? *Beyrichia verrucosa*, Kolmodin, 1869, Sverig. Silur. Ostrac. p. 19, fig. 12.

? *Beyrichia Jonesii*, Kolmodin, 1880, Œfv. K. Vet.-Akad. Fördhandl. vol. xxxvi. p. 137.

B. Jonesii has the middle lobe relatively small and pressed more or less closely against the inner side of one of the lobes. The ventral union of the lobes, usually by a thin isthmus, is variable in extent. Surface of the large lobes granulate or tuberculate. The marginal rim well developed and radiate. In Kolmodin's *B. verrucosa*, which he regards as *B. Jonesii*, the front and hind lobes freely coalesce, and, together with the margin, are tuberculated. In the latter feature this resembles Boll's *B. nodulosa*, otherwise it resembles Boll's fig. 2 (1856) and fig. 8 (1862).

A specimen closely resembling fig. 1 of Boll's *B. Jonesii* has been found by Dr. Holl in the Wenlock Limestone of Eastnor Park, below the Herefordshire Beacon, on the west side, near Malvern.

6. *Beyrichia admixta*, sp. nov. (Pl. XII. fig. 5.)

Proportions :—L. 13. H. 7.

These few, small, oblong valves (Smith Coll. no. 55_2, from Woolhope) have three distinct subequal vertical lobes, evenly united below, and also the beginning or root of an obscure supernumerary lobe, apparently a duplication of the gigot, as if it were to be divided vertically, but only a part of it exposed.

This form is closely allied, if not belonging, to the four-ridged group (*Plurijugatæ*). It evidently requires a distinct name; *admixta* has reference to this intermediate character.

7. *Beyrichia lacunata*, sp. nov. (Pl. XII. figs. 18, 19, 20.)

Proportions: {Figs. 18, 20: L. 12. H. 6.
Fig. 19: L. 11. H. 6.

These oblong little valves vary in dimensions, outline, and contour. Some are longer than others, and then have the ventral margin somewhat incurved, instead of being straight or

slightly convex. The ends are unequally rounded. The valves all bear a raised ridge just within and concentric with the ventral and terminal margins; also three narrow transverse lobes. These freely coalesce below, and, though somewhat variable, yet usually show that one (posterior), which forms a loop at its upper portion (being there either impressed with an oval pit, or formed of two short ridges meeting at top), curves boldly forward below, and makes one with the usually straight middle lobe; whilst another (anterior) ridge-like lobe goes off from (or joins) the root of the others with a variable curve, or even at an angle. The depressed spaces, or sulci, between the lobes, and between them and the strong marginal rim, are deep and broad. The surface of the valves is obscurely pitted. If the loop-like depression on the gigot were open at the top, we should have a four-lobed *Beyrichia*; but in some individuals the anterior and middle lobes keep together in either an oblique or a curved position, and even nearly coalesce at the top (in the antero-dorsal region), as if, intending to form a loop, they would imitate that of the other lobe, and thus make a single, curved, narrow, ridge-like lobe, having a loop (or oval depression) at each end.

The form is rather rare and is new to us; we call it *lacunata*. Barrande's *B. bohemica* (Syst. Sil. B. vol. i. Suppl. p. 498, pl. xxvi. fig. 13, and pl. xxxiv. figs. 18–22) and M'Coy's figures of *B. complicata* (Pal. Foss. Cambr. 1851, p. 136, pl. i. E, fig. 3) approach in character to this species.

Smith Coll. no. 16. Railway-cutting, Severn, Ironbridge.
55. Woolhope.
Vine Coll. no. XLV. Tickwood Beds, nos. 25 and 25*.

II. BOLLIA, gen. nov.

In these Beyrichian Entomostraca the valves bear two lobes meeting below with a thin curved isthmus. They have also a marginal ridge, sometimes unequally divided ventrally. By the lessening of the lobes and the increase of the marginal rim some forms seem to show a passage into *Kirkbya*. The simple horseshoe swelling on the valve differs so much from the *three-lobed* and the *plurijugate Beyrichiæ* and from the *corrugate* form or *Kladenia*, that we propose to give this a generic standing as BOLLIA, in honour of the late Dr. Ernst Boll, of Neubrandenburg (see above, p. 338).

1. *Bollia bicollina*, sp. nov.
(Pl. XII. figs. 14 *a*, *b*, *c*, 15, & 16.)

Proportions: Fig. 14: L. 23. H. 15.
Fig. 15: L. 22. H. 15.
Fig. 16: L. 9. H. 7.

Valves oblong, with rounded and nearly equal ends; some individuals proportionately longer than others; straight on the back, more or less outcurved on the ventral edge. The surface is finely punctate, and bears two lobular elevations, one on each side of a median bay-like sulcus, and constituting two irregular obliquely transverse lobes, which converge downwards and meet near the middle of the ventral region by a low, narrow, bent isthmus, sinuous in the adult, but more simply curved in the young state (fig. 16). The upper or dorsal portions of this horseshoe lobe are swollen and project outwards, and in the larger specimens somewhat divergently, giving a symmetrically pinched and knobbly outline to the dorsal profile of the carapace (fig. 14 *b*). The ventral aspect (fig. 14 *c*) shows the parallel, broad, lower margins conjoined, and a slight median swelling at the curved neck or root of the lobes on the sides; there is also a slight indication of one pair of the lobes more prominent on one side than the other.

There are also two strong semilunar ridges, one at each end of the valve, outside the lobes and parallel with the marginal border, which has a slight outer rim. These two ridges die out opposite each other, below the curved neck of the two large lobes.

In Mr. Vine's collection, nos. XLVIII_{1-4}, LXII, $\text{LXIV}_{12, 13}$, all from the "Buildwas Beds" of the Wenlock Shale.

A small or young form (fig. 16), with essentially the same features as those of *B. bicollina*, occurs in Mr. J. Smith's collection, no. 55_8, from Woolhope.

2. *Bollia uniflexa*, sp. nov. (Pl. XII. figs. 17 *a*, *b*.)

Proportions:—L. 23. H. 16. Th. 10.

Valves nearly semicircular, but somewhat modified by a slope on the antero-ventral edge, where the narrow sharp ridge just within the margin is much reduced in thickness. The middle surface of each valve is raised into a strong somewhat horseshoe-like or subcrescentric lobe, or rather into two broad, suboval, unequal lobes, obliquely transverse to the length of the valve, and united below. They converge rapidly downwards and join ventrally by a narrow sharply curved isthmus. Towards the dorsal border they thicken and bulge out. A

deep median sulcus separates the two limbs of this thick, curved, lobular ridge, and the surface of the valve sinks deeply all round outside the lobes, between them and the narrow ridge which stands just within the fore and aft margins. This submarginal ridge represents the thicker semilunar ridges in *B. bicollina*.

The surface has a reticulate ornament. The dorsal aspect of the carapace is irregularly subovate, blunt at the end, and lumpy at four spots with the ends of the lobes.

At first sight this appears to be possibly a varietal form of the foregoing (p. 361, figs. 14, 15, and 16), but we find no intermediate stages.

This species is evidently an ally of *Bollia colwallensis* (*Beyrichia*), Holl (Geol. Mag. dec. ii. vol. viii. 1881, p. 346, pl. x. fig. 14); and in the simply curved elevation of *B. comma*, Jones (Sil. Foss. Girvan, 1880, p. 219, pl. xv. fig. 9), perhaps we have a distant homologue of the great curved lobe, consituting the characteristic feature both in the unique specimen before us and in *B. bicollina*. These two are closely related; they may be only sexually different, but convenience calls for distinctive names, since a specific standing is possible. The Lower-Silurian *B. Grewingkii*, Bock (Neues Jahrb. &c. 1867, p. 594), according to the description, may also be an ally.

The broader lobes and thinner semilunar ridges, together with the semicircular outline of the valves, distinguish *B. uniflexa* from *B. bicollina*. The dorsal outlines are easily recognized on account of the lobes forming more isolated projections in the latter species.

Vine Coll. no. XXXVIII$_1$ (only one specimen, with *B. Klœdeni*, var. *tuberculata*, Salter), from bed no. 25.

III. Klœdenia, gen. nov. (See above p. 347.)

1. *Klœdenia intermedia*, Jones & Holl, var. *marginata*. (Pl. XII. figs. 21 *a*, *b*.)

Proportions:—L. 9. H. 6. Th. 5.

Beyrichia intermedia, J. & H., Ann. & Mag. Nat. Hist. ser. 4, vol. iii. 1869, p. 218, pl. xv. fig. 7; Jones & Kirkby, *ibid.* vol. xv. p. 55, pl. xvii. fig. 11.

This neat little form, one specimen of which has been collected by Mr. Vine (No. LIV$_{12}$, bed no. 37) agrees with the species referred to above, except that it has a marginal rim, and does not show the little foremost furrow.

It evidently belongs to the same group as *K. Wilckensiana*, namely, what were called the *Beyrichiæ corrugatæ*; and the smooth convexity of the main portion of the valve, the very

short sulci, and the small but prominent midlobe, reaching to the dorsal edge, strongly distinguishing these species, we propose to separate them from their Beyrichian allies, under the generic title of KLŒDENIA (see above, p. 347).

EXPLANATION OF PLATE XII.

[All the figures are magnified 15 diameters, except figs. 8 *b* and 13 *b*.]

Fig. 1. *Beyrichia tuberculata* (Kloden), var. *gibbosa*, Reuter. With the hypertrophied lobe. *a*, right valve; *b*, dorsal view of carapace. Smith Coll. no. $9_{3,4}$. Dudley Castle.

Fig. 2. *Beyrichia Klœdeni*, M'Coy, var. *granulata*, Jones. With the big lobe. Smith Coll. no. 9_1. Dudley Castle.

Fig. 3. *Beyrichia Klœdeni*, M'Coy, subvar. *subspissa*, Jones. *a*, right valve; *b*, dorsal view of carapace. Vine Coll. XLIV_1. Bed 46.

Fig. 4. *Beyrichia Klœdeni*, M'Coy, var. *intermedia*, Jones. Right valve. Smith Coll. no. 55_4. Woolhope.

Fig. 5. *Beyrichia admixta*, sp. nov. Right valve. Smith Coll. no. 55_2. Woolhope.

Fig. 6. *Beyrichia Klœdeni*, M'Coy, var. *subtorosa*, Jones. Left valve, with one sulcus on the gigot. Vine Coll. XLVI. Tickwood Beds.

Fig. 7. The same. With two sulci on the gigot. Smith Coll. no. 34. Woolhope.

Fig. 8. *Beyrichia Klœdeni*, M'Coy, var. *tuberculata*, Salter. *a*, left valve; *b*, portion magnified about 25 diam. Smith Coll. no. 18. Woolhope.

Fig. 9. The same, smaller form, subvar. *clausa*. *a*, right valve; *b*, dorsal view of carapace. Vine Coll. XLVII. Shales over Wenlock Limestone.

Fig. 10. *Beyrichia Klœdeni*, var. *scotica*, nov. Hollow cast of a left valve. Mrs. Gray's Coll. Near Girvan.

Fig. 11. *Beyrichia Maccoyiana*, Jones. *a*, left valve; *b*, dorsal view of carapace; *c*, ventral aspect of carapace. Vine Coll. XLIII_1. Bed 25.

Fig. 12. *Beyrichia Maccoyiana*, Jones. Right valve. Young or variety. Smith Coll. no. 22_8. Lincoln Hill, Ironbridge.

Fig. 13. *Beyrichia Maccoyiana*, Jones. *a*, right valve, with "big lobe;" *b*, portion of the hypertrophied lobe, magnified about 50 diam. Smith Coll. no. 25. Railway-cutting, Ironbridge.

Fig. 14. *Bollia bicollina*, gen. et sp. nov. *a*, left valve; *b*, dorsal view of carapace; *c*, ventral view. Vine Coll. XLVIII_1. Bed 22.

Fig. 15. The same. Right valve. Vine Coll. XLVIII_4. Bed 22.

Fig. 16. The same, young. Left valve. Smith Coll. no. 55_8. Woolhope.

Fig. 17. *Bollia uniflexa*, gen. et sp. nov. *a*, right valve; *b*, dorsal view of the carapace. Vine Coll. XXXVIII_1. Bed 25.

Fig. 18. *Beyrichia lacunata*, sp. nov. Left valve. } Smith Coll. no. 55. Woolhope.

Fig. 19. The same. Right valve. } Vine Coll. XLV. Bed 25.

Fig. 20. The same. Right valve. }

Fig. 21. *Klœdenia intermedia*, Jones & Holl, var. *marginata*, nov. *a*, left valve; *b*, dorsal edge. Vine Coll. LIV_{12}. Bed 37.

Fig. 22. *Beyrichia concinna*, nov. *a*, right valve; *b*, dorsal view of carapace. Smith Coll. no. 19. Dormington, near Stoke-Edith.

XXXI.—*Professor Claus and the Classification of the Arthropoda.* By E. Ray Lankester, M.A., LL.D., F.R.S., Jodrell Professor of Zoology in University College, London.

A translation appeared in the Ann. & Mag. Nat. Hist. for February 1886, p. 168, of a note published by Prof. Claus of Vienna, in the 'Anzeiger' of the Imperial Academy of Sciences of Vienna, December 17, 1885.

The article in question astonished me, since I found that it consisted chiefly of an exposition by Prof. Claus of those views on the classification of the Arthropoda, and especially on the relationship of the Eurypterina and *Limulus* to the Arachnida, which I formulated in 1881, and have for nearly five years defended single-handed. My astonishment was due to the fact that Prof. Claus makes no allusion whatever to my writings on the subject, but puts my views forward as his own. I have in consequence addressed to the Secretary of the "Mathem.-naturwiss. Klasse" of the Imperial Academy of Sciences of Vienna a communication which I wish to place before English readers, inasmuch as Prof. Claus's statement, to which it refers, has been translated and published in this Magazine. The communication is as follows:—

My attention has been called by my colleague Prof. Moseley, of the University of Oxford, to a note by Prof. Claus, of Vienna, published in the 'Anzeiger der kais. Akad. d. Wiss. in Wien' of Dec. 17, 1885, p. 250.

In this communication (as Prof. Moseley has pointed out to me) the views which I published in 1881, in my memoir "Limulus an Arachnid," as to (1) the relationship of the Arachnida to the Gigantostraca and to the Xiphosura, and as to (2) the classification of the Arthropoda, also as to (3) the unnatural character of the divisions Branchiata and Tracheata, and (4) the nature of the antennæ of Hexapoda, Myriapoda, and Peripatus, and the absence of corresponding organs in Arachnida, are adopted and reasserted by Professor Claus.

Professor Claus makes use of the facts adduced by me in order to sustain the theoretical conclusions which he has also taken from me, and he does not add any argument to those which he has thus appropriated. Nevertheless Professor Claus does not mention my name in connexion with this matter, and appears to put forward these views as originating with himself.

I am gratified to find that my learned colleague of the

University of Vienna has at length come to the same conclusion on this subject as that which I published in 1881, and have taught for many years. But I do not think that it is right that he should present these views to the Imperial Academy of Vienna as originating with him when they are well known to the zoological world as having originated with me, and are totally opposed to the views which he himself has hitherto held and taught in his well-known text-book of Zoology.

I appeal therefore to the justice of the members of the Imperial Academy of Sciences of Vienna to permit me to publish in the pages of the same Journal in which Prof. Claus has appropriated my views to himself a statement of my claims to the origination of those views.

I am not able to suppose that Prof. Claus has *independently* come to the same conclusions on this subject as those which I have advocated, inasmuch as he received a copy of my memoir, "Limulus an Arachnid," at the time of its publication four years ago, and has lately, in one of his own publications, referred to statements of mine in an essay on the structure of *Apus cancriformis*, which appeared in the same journal in which that on "Limulus an Arachnid" was published. This memoir was also issued in conjunction with the latter essay under the separate title "Studies on Apus, Limulus, and Scorpio," and was sent by me to Prof. Claus in that form. Apart from the fact that these memoirs were separately and specially sent to Prof. Claus by me, I have good reason to believe that he does not neglect to make himself acquainted with the contents of the 'Quarterly Journal of Microscopical Science,' in which periodical they were first published. I must therefore conclude that my essay "Limulus an Arachnid" was known to Prof. Claus.

I will now proceed to quote certain passages from Prof. Claus's recent note in the 'Anzeiger' of the Academy, and compare them with passages from my memoir of four years since.

I. Prof. Claus says, "the Mites are degraded members of the class Arachnoidea." This view I had already advocated in my little book 'Degeneration' (Macmillan & Co., London, 1880), p. 50. It is also expressed in the memoir "Limulus an Arachnid," where I have classified the Arachnida * in three grades, viz.:—1, Hæmatobranchia, including the Gigan-

* I have since proposed (Trans. Zool. Soc. vol. xi. p. 379) to modify these terms as follows, viz.:—1, Delobranchia; 2, Embolobranchia; 3, Lipobranchia.

tostraca and Limulus; 2, Aerobranchia, including the Scorpions and Spiders; and 3, Lipobranchia, including the Pseudoscorpiones, Galeodes, the Opiliones, and Acarina.

II. Prof. Claus says, "the class Arachnoidea, the starting-point of which must probably be sought in the great Palæozoic Gigantostraca with their resemblance to the Scorpions, hitherto regarded as Crustacea upon insufficient grounds."

It would be more correct to say, "hitherto regarded by Professor Claus as Crustacea upon insufficient grounds," since the close affinity of *Limulus* and the Gigantostraca to the Scorpions was demonstrated in my memoir "Limulus an Arachnid," published as long ago as 1881. The whole purpose of that memoir was to establish this close affinity. That purpose was effected by a detailed comparison of segment with segment and organ with organ in the two series of Arthropods compared. I showed not only that the segments agreed with one another in *Limulus* and the Scorpion, but that the position and modification of such important parts as the genital opercula is actually coincident, and that the chilaria (metastoma) of *Limulus* and the Gigantostraca (often erroneously reckoned as modified limbs) are identical with the metasternum of *Scorpio*. I was able to show that the gill-books of *Limulus* agree in structure and position with the pectines and the lung-books of *Scorpio*. I have since, in other memoirs, demonstrated the exact equivalence in minute structure and general relations of (1) the internal cartilaginoid sternum or entochondrite of *Limulus*, *Scorpio*, and *Mygale* (Quart. Journ. Micr. Science, January 1884); (2) of the lateral and central eyes of *Limulus* and *Scorpio* (Quart. Journ. Micr. Sci. January 1883); and (3) of the coxal glands of *Limulus* with the similar glands discovered by me in *Scorpio* and *Mygale* (Quart. Journ. Micr. Sci. 1884, and Proceed. Roy. Soc. 1882). Other points of agreement I have also insisted upon in the above memoirs, and in one just published by the Zoological Society of London (Trans. Zool. Soc. vol. xi. 1885), which I will not here further enumerate.

It seems to me an extraordinary thing that Prof. Claus should omit all reference to these published researches and the conclusions formulated by me, and should declare that "hitherto" (that is to say until the publication of his Note in the 'Anzeiger' of the Imperial Academy) the Palæozoic Gigantostraca have been regarded as Crustacea.

III. Professor Claus proceeds further to say:—"Hitherto, evidently, far too much stress has been laid upon this last agreement [viz. branchial respiration] in the division of the Arthropoda into Branchiata and Tracheata, without taking

into consideration that the breathing by air-spaces may have been developed in different ways and at different times in the terrestrial forms, and that consequently no primarily decisive morphological value is to be ascribed even to the possession of tracheæ." Here again Prof. Claus is simply repeating a statement made four years ago by me in the following words; his "hitherto" is totally without justification, excepting so far as it applies to his own systematic treatises.

In "Limulus an Arachnid" I say, "Whatever may be the conclusion arrived at in the future in reference to the affinities of the Hexapoda and Myriapoda, the result of the recognition of the intimate relationship of Scorpio and Limulus must be, I think, to break up the artificial group of Arthropoda Tracheata by the separation of the Scorpions, Spiders, and Mites from any special connexion with it." And again, in another passage of the same essay, my words run: "It seems to be in the highest degree probable that there is no such a group to be recognized as the Tracheata. Tracheæ have probably developed independently in Peripatus, the Insecta, and again in Arachnida."

IV. Proceeding to formulate the conclusions which he has taken bodily from me as to the probable genealogy of the chief groups of the Arthropoda, Prof. Claus states that the stem of the Crustacea and that of the Arachnida are united at the base, whilst the Insecta Hexapoda and Myriapoda form a third series, "for the derivation of which the remarkable Annelid-like Onychophora (Peripatus) appear to be so significant."

This is a simple and direct description in words of the genealogical tree of the Arthropoda given at the end of my article "Limulus an Arachnid," with this difference, that whilst I have represented the Crustacea and the Arachnida as two main stems with a common base, and *Peripatus* as a third and independent stem, I have indicated a hesitation to decide on referring the Insecta Hexapoda and Myriapoda to the stem of *Peripatus* absolutely, and have considered the possibility of their derivation from either the Arthrostracous Crustacea or the tracheate Arachnida.

In the text of the essay I have, however, weighed the three possibilities suggested, and have given the reasons for considering the Insecta Hexapoda and Myriapoda to be derived from *Peripatus*. The most important of these reasons is pointed out by me to be dependent on the character of the antennæ of the Crustacea on the one hand, and of those of *Peripatus* and of the Insecta Hexapoda and Myriapoda on the other hand—the latter being apparently identical with the

prostomial tentacles of Chætopod worms, and not (as I suggested, in 1873, are the antennæ of the Crustacea) truly postoral appendages which have acquired a secondary præoral character by the backward shifting of the oral aperture. This view as to the Chætopod affinities of the antennæ of *Peripatus* and Insecta, and as to the contrasted and totally distinct origin of the Crustacean antennæ, is adopted from my writings by Prof. Claus. My words in "Limulus an Arachnid" are: "The antennæ of Hexapods and of Myriapods may be, as probably are those of Peripatus, non-appendicular prostomial antennæ." And again, "The antennæ of Peripatus probably are identical with the similar organs of Chætopoda, and are *not* originally postoral appendages." Further, in the memoir on the "Appendages and Nervous System of Apus," published in the Quart. Journ. Micr. Sci. in 1881, I say (p. 368):—

"I have long been of the opinion which Professor Claus appears to hold, that the appendages of the Arthropoda are homologous (or, to use a more distinctive term, 'homogeneous') with the appendages of the Chætopoda; and on this account I consider it a proper step in classification to associate the Chætopoda with the Arthropoda and Rotifera in one large phylum, the Appendiculata (see "Notes on Embryology and Classification," Quart. Journ. Micr Sci. 1876, and Preface to the English translation of Gegenbaur's 'Elements of Comparative Anatomy').

"At the same time I have not been led to conclude, as does Prof. Claus, that only one pair of the Crustacean antennæ are to be regarded as primarily postoral in position and as representing the appendages of an originally postoral somite *; but I think it probable that *both* antennæ are in this case, and that in the Crustacea there is no representative of the antennæ or tactile processes of the cephalic lobe of Chætopoda. Whilst this appears to me probable in regard to the Crustacea, it yet seems to me very possible that the antennæ of Peripatus and of Hexapod and Myriapod insects may represent true processes of the cephalic lobe or prostomium, as seen in Chætopoda."

I have independent reason for concluding that Professor Claus has read the passage just quoted. He makes use of it in giving the characters of the three stems of Arthropoda, which he now adopts in accordance with my views as follows, so far as the question of antennæ is concerned.

He gives as characters :—" Series I. (Crustacea). Two

* By an error of the press the original here quoted reads "two originally postoral somites"— E. R. L.

pairs of antennæ, the second of which represents the first pair of trunk-members removed forwards.—Series II. (Gigantostraca, Arachnoidea). Absence of the anterior antennæ.—Series III. (Onychophora, Myriapoda, Insecta). With an rior pair of antennæ, representing the frontal tentacles of the Annelida."

With the exception of the fact (to which I will return below) that Professor Claus regards only the second instead of both pairs of Crustacean antennæ as representing trunk-members which have been removed forwards, this statement is identical with that made by me as follows in "Limulus an Arachnid," and is contrary to the views advocated by Professor Claus prior to my publication. Speaking of the probable ancestral history of the three great stems of Arthropoda recognized by me and now adopted without acknowledgment by Professor Claus, I say:—"In the interval between the giving off of Peripatus and the production of the Phyllopod-like ancestors of the Crustacea from the aquatic Pro-Arthropoda a vast change had to be effected in regard to appendages, as well as in the fusing of the nerve-cords, abolition of nephridia, production of a compound eye, striation of muscular tissue, &c. The *prostomial antennæ disappeared*, and their place was taken first by one, then by two pairs of postoral appendages, which gradually acquired a præoral position, as actually occurs in their individual growth in the embryo at the present day. . . . The other appendages probably all acquired at one stage a development of their basal portion, which served as an accessory organ for the purpose of bringing food to the mouth and, in some degree, in crushing such food (as seen in Apus). . . . The definite Crustacean character was attained when two pairs of appendages had become præoral and at least three pairs specialized as jaws and no longer locomotor. . . . Probably none of the known Merostomata suffice to give us a true picture of the structure of the ancestral Merostomata from which they were all derived. Probably these ancestral Merostomata were *devoid of the prostomial antennæ*—the non-appendicular antennæ. At the same time none of their postoral appendages had become definitely præoral in position and nerve-supply, though not less and probably not more than six pairs of pediform appendages were closely set round the mouth, their bases acting as powerful manducatory organs."

I then proceed to state the probable mode of the derivation of the Xiphosura, the Eurypterina, and the living Arachnida from these primitive Arachnids, destitute both of the prostomial antennæ characterizing *Peripatus* and its descendants,

and of the migrated substitutional antennæ (postoral appendages which have become præoral) of the Crustacean series.

V. With regard to the fundamental theory on which these views as to the difference of the nature of the antennæ in Crustacea on the one hand and in *Peripatus*, Hexapods, and Myriapods on the other hand depend, namely the theory that a forward movement of limbs or appendages belonging to body-segments has taken place in the Crustacea, so as to make appendages which were originally postoral actually præoral, it appears that my publication in 1873 in the Ann. & Mag. Nat. Hist., entitled "The Primitive Cell-layers of the Embryo as the Basis of Genealogical Classification of Animals," contains its first expression, and is anterior to the adoption of any such view by Prof. Claus even in regard to the limited sphere of application offered by the second pair of Crustacean antennæ. I do not find this theory of the movement forwards of a pair of postoral limbs so as to become præoral antennæ expressed in the editions of Prof. Claus's 'Grundzüge der Zoologie' which preceded the publication of my suggestion on this subject, nor has he clearly formulated it until the present occasion. In the Ann. & Mag. Nat. Hist for May 1873, p. 336, I wrote:—"Much more likely, it seems, is the explanation that the oral aperture shifts position, and that the ophthalmic segment alone in Arthropoda represents the prostomium, the antennary and antennular segments being aboriginally metastomial and only prostomial by later adaptational shifting of the oral aperture."

VI. With regard to the one point in the morphology of the Arthropoda in regard to which Professor Claus has refrained from adopting my views I may say a few words. The difference between us is this: I have suggested that both the first and second pairs of Crustacean antennæ were originally postoral appendages (limbs of the body-segments), and have nothing to do with the prostomium. Professor Claus holds that the first pair of Crustacean antennæ are truly prostomial and comparable to the Annelids' prostomial tentacles, whilst he has adopted my theory of 1873 in so far only as the second pair of antennæ are concerned.

There are reasons for and against each of these views as to the nature of the first pair of Crustacean antennæ. But I will here only observe that, in accordance with my view of their nature, the fact that the first pair of appendages must have shifted forward at an earlier period in ancestral history than the second explains in a large measure the closer and more constant association of their nerve-supply with the cerebral ganglion and their somewhat greater departure from

the normal form of somatic appendages than is observed in regard to the second pair. I do not think it improbable that at some future date Professor Claus may adopt the view which I have advocated as to the first, just as he has adopted it in regard to the second pair of Crustacean antennæ; and I am therefore anxious to take the present opportunity of insisting upon an important piece of evidence in its favour which has come to light through my researches on the relationship of *Limulus* to the Arachnida. Packard, as is well known, discovered the "brick-red glands" of Limulus, the structure of which I have since investigated (Quart. Journ. Micr. Sci. January 1884). These glands are similar in essential structure to the "shell-gland" of the Entomostracous Crustacea. I discovered that they exist in *Scorpio* and also in *Mygale* in a highly developed condition, and have given to them the name "coxal glands," on account of their relation to the coxæ of the prosomatic appendages. In none of the Arachnids (*Limulus*, *Scorpio*, and *Mygale*) do these glands open to the exterior in the adult animal But Mr. Gulland, in my laboratory in London, and Mr. Kingsley, in Boston, Mass., have independently ascertained that in the young Limulus *the coxal gland opens to the exterior on the basal joint of the fifth pair of appendages* (Quart. Journ. Micr. Sci. 1885). Now in the Crustacea Entomostraca the shell-gland opens to the exterior at the base of the second pair of maxillæ. If we reckon the first pair of Crustacean antennæ as the equivalent of the first pair of appendages of the Arachnida, as is the case according to my long since published view of their nature, then we arrive at the striking result, pointed out by Kingsley, that the Crustacean shell-gland and the Arachnidan coxal gland *open in both cases at the base of the fifth pair of appendages.* On the other hand, if Professor Claus is right in considering the first pair of Crustacean antennæ as essentially prostomial, and in regarding the first pair of Arachnidan appendages as the equivalent of the second pair of Crustacean antennæ, then the shell-gland of Entomostraca loses its agreement in position with the coxal glands of Arachnida, and has to be assigned to the fourth pair of true somatic appendages instead of the fifth. The argument is, I admit, not a conclusive one, since the Pro-Arthropod must have been, like *Peripatus*, provided with a nephridium (from which shell-gland and coxal gland are derived) at the base of each pair of appendages. Nevertheless it has weight in a question which can only be decided by the accumulation of converging evidence; and it is, *cæteris paribus*, more likely that the coxal glands and the shell-

gland are identical nephridia than that they represent those of different segments.

VII. Lastly, I wish briefly to point out that Professor Edouard Van Beneden of Liège was the first naturalist since Straus-Dürckheim to insist upon the necessity of regarding *Limulus* as an Arachnid. In 1871 (Société Entomologique de Belgique) he briefly expressed this view as the result of an examination of the embryos of *Limulus*; but he did not attempt to support it by any detailed comparison of the organization of the Xiphosura, Eurypterina, and Arachnida.

Had Professor Claus done justice to his predecessors in the discussion of the classification of the Arthropoda, he would have cited the views of the professor of Liège as well as my own detailed observations and speculations, which, I am glad to acknowledge, owe their existence to the brief but suggestive publication of my friend Edouard Van Beneden.

XXXII.—*Contributions towards the Knowledge of the Nervous and Muscular Systems of the Horny Sponges.* By Dr. R. VON LENDENFELD*.

ONE of the Australian species of *Euspongia*, which is identical with *Euspongia anfractuosa*, Carter †, shows in many respects remarkable differences from the known structure‡ of the common bath-sponge, *Euspongia officinalis*. The sponge is massive, and has short, rounded, finger-like processes. Each of the latter contains a wide cylindrical cavity running in the direction of its length, and which externally looks very like a wide oscular tube. These wide tubes open below into a system of anastomosing lacunæ. The whole dermis is rich in pores. A very elegant sand-net is diffused between the regularly distributed pore-sieves. On closer examination it is seen that the tubes in the digitiform processes are lined with a membrane of exactly the same structure. This applies also to the lining of the lacunose cavities in the interior of the sponge. The tubes and lacunæ are not oscular tubes, and do not belong to the true sponge-body, but form a vestibular

* Translated by W. S. Dallas, F.L.S., from the 'Sitzungsberichte der königl. preussischen Akademie der Wissenschaften zu Berlin,' 1885, pp. 1015–1020.

† Ann. & Mag. Nat. Hist. ser. 5, vol. xv. p. 316.

‡ F. E. Schulze, "Untersuchungen über den Bau und die Entwickelung der Spongien.—VII. Mittheilung. Die Familie der Spongidæ" (Zeitschr. f. wiss. Zool. Bd. xxxii. pp. 591 *et seqq.*).

space, which is connected only with the afferent canal-system. On the inner surface of the tubes and in the walls of the lacunæ no oscula are to be found. This vestibular structure consequently differs considerably from that which I have described in the case of the Aulenidæ *. It resembles that occurring in the *Nardorus* forms.

The oscula are small and are always arranged in rows. These rows traverse the finger-like processes in a longitudinal direction. The finger-like processes are 10–20 millim. thick, and of about the same length. The oscula are 1–2 millim. broad, circular, and placed at pretty regular distances of 10–15 millim. apart.

In the skeletons we see no trace of oscula. In place of the rows of oscula there are in them deep furrows, which sometimes extend down into the central pseudo-oscular tube. In the living sponge nothing can be seen of these furrows, which are completely filled with sponge-tissue. It is true that this tissue has no skeletal support, and in dried specimens this part appears much depressed and as having fallen in.

In transverse sections we see that the tissue which forms this part is very loose and lacunar. The groups of flagellate chambers between the broad and irregular, generally longitudinally-directed canals are small and not very numerous, in fact far less numerous than those of the much denser skeletiferous part, which is furnished only with small canals. These large canals and lacunæ coalesce to form the short oscular tube; they all belong to the efferent system.

While even in this furrow and its structure we have a remarkable peculiarity presented to us, we find much more interesting characters on careful microscopic examination.

The skeleton is a very finely reticulate *Euspongia* skeleton. The main radial fibres are but little branched and bear sand. The uniting fibres, on the contrary, are free from foreign bodies and much ramified. They form numerous anastomoses. Their average thickness differs in the different varieties, and varies between 0·01 and 0·02 millim. At the margin of the furrow all these uniting fibres terminate in very sharp ensiform points, which stand so close together that the wall of the furrow appears densely spinose. There can be no doubt that this spinosity is a defensive arrangement against such foreign intruders as may attempt to penetrate into the sponge-body from the wide oscular tubes and lacunæ of the efferent system.

* Lendenfeld, "Ueber den Bau der Hornschwamme," Zool. Anzeiger, 1885.

From the pointed ends of the horny fibres descends a membrane which completely separates the lacunar tissue of the groove from the rest of the sponge-body. Below this membrane is repeatedly interrupted, and here the efferent canals come through. We find a membrane of this kind on each side of the lacunar groove, and these membranes line the side-walls of the groove throughout their whole length.

On close examination of thin transverse sections it is seen that this membrane is composed of parallel fusiform cells, which stand perpendicularly to the outer surface of the sponge, all of them descending radially towards its interior. They form several layers in the above-mentioned membrane—generally three. The membrane itself is of uniform thickness throughout. These cells run out at both ends into extremely fine points. They are 0·1 millim. in length and 0·003 millim. in breadth at the middle. The oval nucleus is placed about the middle of the length; it is, however, not placed axially, but more or less laterally. In the neighbourhood of the nucleus there is a very small quantity of ordinary protoplasm, while all the rest of the cell consists of a substance which differs essentially from the contents of ordinary fusiform cells. Thus it contains distinct, small, but strongly and *doubly* refractive, rounded granules, imbedded in a homogeneous transparent substance which is but slightly and simply refractive. The granules are in part very regularly arranged, so that a sort of *transverse striation* of the fibres is produced. The granules do not combine to form doubly refractive disks, and the regularity of their arrangement is not always equal in degree. In examining material in spirit one easily sees that these membranes of the walls of the groove are strongly contractile, and, indeed, that they always contract in a *radial* direction. By this means the outer surface of the tissue occupying the groove is more or less lowered; and in the very considerable variation of depth to which the surface of the tissue occupying the groove sinks in different specimens, we have the expression of the action of the radial contractions of these membranes.

I think we may conclude from the above-cited observations that these membranes are muscles and the cells composing them muscle cells; and, further, that these muscle-cells in their peculiar structure make the transition from the smooth to the transversely-striated fibres.

In transverse sections through the margins of the groove we see that a peculiar organ is seated upon the upper outer margin of this muscular membrane. We then find the membrane suddenly increased to twice or three times its diameter

elsewhere. This line of thickening can be accurately studied in thin sections, when we find that it does not consist of fusiform cells. Large globular nuclei are very distinct here, and these appear to be imbedded in a granular substance. This substance no doubt belongs to cells the boundaries of which are not distinct. From this marginal thickening granular threads issue laterally, which run tangentially in the exterior dermis of the sponge, and may sometimes be traced to considerable distances. Above, on these distal thickenings of the muscular lamella, there stand fusiform sense-cells. The basal extremities of all these cells, which are diffused over a tolerably broad zone, are curved towards the above-mentioned thickening, and stand in direct connexion therewith. No ramification of the basal process was observed. The cell-body itself has the ordinary form. The cells are about 0·03 millim. long, and 0·002 millim. broad in the middle at the nuclear dilatation. In the cell-body, after treatment with osmium, we find those characteristic dark granules which have been discovered by Jickeli * in the sense-cells of the Hydroida, and which also occur in the sense-cells of the Sponges, and here furnish a particularly distinct and valuable criterion.

I believe that the above-described structures on the distal margin of the muscular membrane are to be interpreted as follows :—

The whole thickening, which is interrupted only here and there, consists of ganglion-cells, the nuclei of which are distinct in preparations, although their contours do not appear distinctly. The granular threads which are given off from these ganglia in a tangential direction are nerves which establish the connexion of the ganglia with more distant and at present still unknown structures.

From the above description it appears that the zone of sense-cells runs along the upper margin of the muscular membrane, so that two bands of sense-cells are formed, bordering the tissue filling the groove at the surface.

I believe that this structure of our sponge may be directly compared with the *annular nerve* of the Cycloneural Medusæ (Eimer), and indicates that the Sponges, being capable of a development similar to that of those Cnidaria, were probably not so very different from them as we commonly suppose. It must indeed be admitted that, by *convergent* development, a resemblance may here have been produced which does not justify any phylogenetic conclusions, especially as these structures in the Sponges are mesodermal and not subepithe-

* "Ueber den Bau der Hydroidpolypen," in Morphol. Jahrbuch, Bd. viii.

lial as in the Hydromedusæ. To enter into more detail upon this subject, however, would lead us further than seems to be permissible in a preliminary communication.

If I now glance back briefly over our knowledge of the nervous and muscular tissues of the Sponges, it may, on the one hand, be useful to my *collaborateurs* in this department; while, on the other hand, such a summary may serve as a foundation for general morphological investigations.

In the first place, F. E. Schulze, the founder of modern spongiology, demonstrated that in many sponges particular fibre-cells, and even combinations of fibre-cells, are contractile. This discovery that the long-known movements of adult sponges (larvæ, young *Spongillæ*, &c. move without contractions of fibre-cells) are caused, not by a contraction of the fundamental substance or of the epithelia, but by contraction of definite elements adapted to this purpose, has been repeatedly confirmed by myself and others.

In the year 1880 C. Stewart demonstrated "palpocils" in *Grantia compressa* before a meeting of the English Royal Microscopical Society. I am not in a position to offer any opinion upon this statement, which only came to my knowledge a few months ago. I indeed regard the existence of sense-hairs upon the sense-cells discovered by me as probable upon *à priori* grounds, but I have never seen palpocils.

I have investigated a number of Australian Calcispongiæ, Myxospongiæ, and Horny Sponges, and have found upon some, although only a few of them, cells which I regarded as nervous. Among the Horny Sponges I have hitherto tested in this respect only the Auleninæ and the genus *Euspongia* (the Australian species). The actual results in these groups are as follows:—

Sycandra arborea, Häckel. The sense-cells form a ring at the entrance of the afferent canals.

Grantessa sacca, R. v. L. The sense-cells stand in groups at the entrance to the afferent canals.

Vosmæria gracilis, R. v. L., and *Sycandra pila*, R. v. L. The sense-cells stand in groups at a greater distance around the incurrent apertures.

Leucandra saccharata, Häckel, and *Leucandra meandrina*, R. v. L. The sense-cells stand in groups which are scattered irregularly over the surface.

Leucetta microrhaphis and *Leucaltis helena*, R. v. L. The sense-cells are scattered singly over the surface, but appear to be more numerous in the vicinity of the incurrent orifices.

Aulena villosa, R. v. L. The sense-cells are placed in

small groups at the lines of union of the membranes, which are extended in the vestibular space.

Halme globosa, R. v. L. The sense-cells stand in groups at the edges of the membrane which are extended in the lacunar spaces of the afferent canal-system.

Euspongia canaliculata, R. v. L. The sense-cells form zones which surround at the surface the lacunar dilatation of the efferent canal-system.

These isolated observations do not enable us to draw any general conclusion, as the observations on the various species are so very different.

I have already indicated * that Schulze's denomination of the contractile elements as "contractile fibre-cells" is no longer necessary, and may now be replaced by the designation "muscle-cells," seeing that nervous elements have been found with them.

Both the muscle- and nerve-cells are *mesodermal*. The *epithelia* of the Sponges nowhere appear to be further developed after the fashion of the higher Cœlenterata. Both endoderm and ectoderm always remain simple †.

XXXIII.—*A few Remarks on Mr. Butler's Notes on the Genus* Terias. By W. L. Distant.

In the last number of this Magazine I have read with no inconsiderable interest a paper by my friend Mr. Butler, entitled "Notes on the Genus *Terias*." In this communication the author, after expressing the very sound opinion that "it is quite impossible for any one, in our present profound ignorance of the earlier stages of most of the species and our imperfect knowledge of those of all, to lay down the law as to which of these forms is worthy of a distinctive name and which not," has still been compelled to describe *twelve* new species, and also to again do me the kindness of not only reviewing some of my recent work, but also to contribute much readable criticism thereon, and to offer many alternative suggestions for my consideration. Under these circumstances I have felt it would be discourteous to any longer refrain from affording such explanation as is possible to one who has taken the trouble to read my remarks, and also I have considered it necessary to myself to show that the views I had the temerity

* Zoologischer Anzeiger, no. 186.

† Häckel has described some Calcisponges with locally plurilamellar endoderm, but hitherto this statement has not been confirmed. See also Vosmaer in Bronn's 'Klassen und Ordnungen des Thierreiches: Porifera.'

to state remain entirely unmodified, but rather strengthened, by the criticism which Mr. Butler has presented.

I will further preface my remarks by an assurance to my friend that I am actuated by no splenetic motive, that I have no belief that anything that can be adduced or argued can now alter or modify the various specific dogmas with which his name is, and will be, indissolubly united; nor do I, on the other hand, imagine that such criticism as he has afforded on my behalf is less friendly than that which he has already presented to most of his contemporaries. At the same time, I cannot disguise the fact that in following Mr. Butler through any monographic paper which he has written, I have seldom failed to have the misfortune of disagreeing with some of his specific discriminations, and have sometimes not hesitated to publish my dissent from the same.

The opening of this *Teriad* campaign will be found in the 'Annals' for 1885, vol. xvi. p. 336, where, after some few paragraphs, the following peroration is reached:—"However I am willing to accept his admission—a rash one for an entomologist to make—'I treat this species as a variety' (see p. 321). I know of many lepidopterists who do this; but Mr. Distant is the first who has boldly come forward and confessed it."

Now this formidable quotation is a statement which, I am glad to have an opportunity of stating, still in every way exactly expresses my views. The meaning is very simple and very clear. Boisduval described what I consider a form of *Nepheronia hippia* as a distinct species under another name, and I could only write, "I treat this species" (meaning Boisduval's creation) "as a variety of *N. hippia.*" Mr. Butler has described many "species" (probably even excelling the number of those of Walker), and naturally not a few of these have been, and are constantly (though termed "species"), treated by some entomologists as simple varieties of other species. Hence I am afraid I cannot accept Mr. Butler's great compliment of being "the first who has boldly come forward and confessed it."

We now come to the question of the value of "types," and how far a species shall be regarded as defined by a description without an actual examination of the specimen described. A figure hitherto has been considered decisive, especially when drawn by or under the hands of the original describer. But now a new case is cited by Mr. Butler, for which no precedent exists. In 1869 he described a species under the name of *Thyca ithiela* as from Penang. In 1871 he figured it under the name of *Delias ithiela*, still

giving the same habitat, and repeated the information in a third organ of publication in 1872. I reproduced the figure and description in my 'Rhopalocera Malayana,' the habitat "Penang" compelling its insertion. We are now informed that the locality was an error, as the type was labelled thus: "P.," which with Wallace's specimens denotes "Penang," but with specimens received from the East India Company represents "Darjeeling, *Pearson*." It is now opined that it came from the last-named locality, and it is stated that "had Mr. Distant examined my type, which, by his own admission, he did not do, he would have avoided the repetition of this error." Surely this logically implies two axioms, viz. (1) Mr. Butler's recorded localities cannot be taken without an examination and verification of the labels attached to his "types;" and (2) if "types" are not contained in this country, neither names nor localities should be used.

"*Terias senna*, Feld."

Mr. Butler states that I have figured what he considers and described as a distinct species (*T. inanata*) as the *T. senna*, Feld. If this is so, then I appear to have erred in describing *T. inanata* as a variety of *T. senna*, and I should more correctly have treated it as a simple synonym of that species. I examined Mr. Butler's "species" in the national collection before I wrote, and, though words may be found to represent differences, I certainly failed to see any exhibited in the specimens themselves that appeared to warrant their differentiation. Mr. Butler quotes Felder's differential diagnosis between *T. senna* and *T. santana* with approval. If these are distinct, why did he in another Teriad paper, published in 1871, enumerate *Terias senna* as a variety of *T. santana*? If, however, we turn to Mr. Butler's original description of his *T. inanata*, we read that it only differs from other specimens which he described under the name of *T. hebridina* by "the entire absence of markings on the under surface of the wings." Now I have figured two specimens of *T. senna*, one with markings underneath and one with those markings absent; and therefore if, as Mr. Butler says, I have in this way figured his species, then his description must be wrong. Again, he has figured this *T. hebridina* (P. Z. S. 1875, pl. lxvii. fig. 8), from which he says his *T. inanata* does not differ on the upper surface; and surely "every candid reader" to whom he rightly appeals must be struck with the dissimilarity between that figure and those given by myself. Probably some explanation was inadvertently omitted.

"*Terias æsiope*, Mén."

Mr. Butler remarks that I have figured as this species a male variety of *T. hecabe*, which is quite true, and it is strange that though this is considered heterodox to-day, he wrote of that species himself, in a former Teriad paper, "Probably a form of *T. hecabe*." I now come, however, to a less pleasant statement, and one which Mr. Butler must be the first to acknowledge as of a misrepresentative character, when he affirms that, amongst other localities for this form, I have given the "somewhat wide one of continental India." The habitat I gave is "Continental India; Bombay." It would surely be quite as correct to say that the "somewhat wide one" of Mexico is given in the 'Biologia Centrali-Americana,' because the primary division is there given before the smaller habitats which it comprises. I did not imply that Mr. Butler was unaware that Bombay was in continental India, but only followed the usual monographic method of giving the habitat of the species. Mr. Butler speaks of the "true *T. æsiope*;" but surely this must be difficult to define, as the species is clearly varietal on his own authority (Trans. Ent. Soc. 1879, p. 7). He there also states that the species has been received from Cachar, N.E. India; but he now implies that it is confined to China, Formosa, and Hainan.

"*Terias sari*, Horsf."

Mr. Butler doubts that I have correctly figured the typical form of *T. sari*, as I have affirmed, and thinks "it far more likely" that a Bornean male specimen in the British Museum is typical of the species. I did not make this determination upon any opinion of my own, but from a comparison with a specimen labelled typical in the collection of Mr. F. Moore, and upon the authority of that lepidopterist, who, as is well known, was once intimately associated with the work of Dr. Horsfield. Mr. Butler can easily examine that specimen for himself, for it is in the collection of a mutual friend, at whose house we have spent many pleasant hours together, and to whom both he and I are indebted for much information regarding oriental Lepidoptera.

I now take leave of a discussion which possesses little scientific value. My friend Mr. Butler holds the proud position of being delegated to look after the national collection of Lepidoptera, and seeks conscientiously to fulfil his duty by industriously describing and naming the specimens placed

under his charge. If others, beside myself, hold a sceptical opinion as to the universal efficacy of this operation, we have at least the satisfaction of knowing that the "types" are contained where they can be examined, and where possibly at some future day a few of them at least may be relegated back to what we are heretical enough to think is their more proper position.

BIBLIOGRAPHICAL NOTICE.

Evolution without Natural Selection; or, the Segregation of Species without the Aid of the Darwinian Hypothesis. By CHARLES DIXON. Small 8vo. London: R. H. Porter, 1885.

IN all matters of opinion, in politics, philosophy, and religion, we find the partisans of one view or the other in possession of certain cabalistic terms or phrases which are supposed by them to settle all difficulties. It would be hard upon the naturalists to be without a shibboleth of this kind, and accordingly since the publication of Mr. Darwin's 'Origin of Species' the term "Natural Selection" adopted by that great naturalist has been freely employed by a great number of his followers as a formula of this nature. In all questions relating to species and their affinities disputes were considered to be closed by the use of this mysterious expression, and it is no doubt in opposition to this employment of the term "Natural Selection" that Mr. Dixon has produced the little book of which the title stands at the head of this article. Unfortunately, however, the author does not seem to have realized more clearly than his presumed opponents the precise sense in which the phrase was used by Darwin. From the whole construction of the volume on the 'Origin of Species' and the line of argument followed in it the meaning attached to the term in the mind of its originator is perfectly clear. Starting from the demonstration of the production, in the case of domestic animals, of a set of varieties so widely differing in character that if met with in nature they would certainly have been regarded as distinct species, these extreme varieties having been produced by the deliberate selective action of man, taking advantage of comparatively small accidental differences, Darwin proceeded to show that an analogous process may very well have occurred in nature, and being, in the lapse of time, carried even still further, may have given origin to true species in the physiological sense of the term. And "artificial" or "methodical selection" by man having been shown to be the cause of the great variations in certain domestic animals, he somewhat metaphorically employed the term "Natural Selection" to express the sum of the actions upon which he considered the origin of still wider variations in nature to depend. But Natural Selection in the Darwinian

sense is not a single phenomenon, but the result of a great number of factors, which were developed with wonderful power by the great naturalist whose works have revolutionized modern thought, even in quarters which might seem to lie beyond the influence of the student of natural history.

On looking into Mr. Dixon's book to see what are the phenomena which he places instead of the undoubted factors in Natural Selection, we find his work divided into five sections, treating in order of Isolation, Climatic Influences, Use and Disuse of Organs, Sexual Selection, and Interbreeding. Of these the first four are manifestly factors in "Natural Selection" in the Darwinian sense; in fact the whole of them were referred to by Darwin at greater or less length in his various writings.

To take the case of Isolation, to which the author devotes the longest chapter of his book. It is perfectly clear that in "methodical selection" the *practical* isolation of the individuals presenting the particular characters which the breeder wishes to perpetuate or intensify is absolutely indispensable; and the same thing must also be effected in nature, free interbreeding, as Mr. Dixon himself admits, having the effect of preventing the production of sharply-defined forms. Practical isolation is an important factor in Natural Selection.

Mr. Dixon, however, does not see this. For example, he says:—"Take, for instance, *Catharus gristeiceps* and *C. phæopleurus*, only distinguished by the shade of colour on the back. In the former species it is russet-brown, in the latter it is olive-brown. *C. griseiceps* has only been obtained on the highlands of Panama, whilst *C. phæopleurus* is apparently confined to the mountain-forests of Antioquia in Colombia. Undoubtedly these two species at no very remote period were one. Circumstances arose that divided the area of its distribution, sending one portion up the highlands of Panama, the other up those of Colombia. Our single species is now isolated into two colonies: perhaps *C. griseiceps* was exposed to a more pluvial climate, causing it to gradually develop a russet-brown back. The two colonies never intermarried; the slight differences would therefore soon become constant by Isolation, and finally the result is as we see it at the present time—two nearly allied, but apparently perfectly distinct, species inhabiting different areas of distribution. No Natural Selection could possibly have been at work in such a case" [but it is itself a case of Natural Selection]; "for it could have served no beneficial purpose. It was no *advantage* for either colony to possess those differences that have finally become constant characters" [but how do we know this?]; "they gave their fortunate possessors no favour in the struggle for life—a russet back was no more advantage to its possessor than an olive back" [then why did the variation occur?], "though both have been preserved, not by the survival of the fittest, but simply by Isolation." Evidently, however, there must have been a "survival of the fittest," unless the changes involved be assumed to have taken place *per saltum* immediately after the change of conditions.

It will be seen from the above extract that the author holds that variations of which we cannot see the advantage are necessarily not advantageous; but until we know something more of the causes of variation it is hardly safe to argue from such premisses. Further, from this and other passages it is clear that he attaches too realistic a meaning to the "struggle for life." He seems to regard it too much as a literal *struggle*, whereas, in the Darwinian sense, while it undoubtedly includes positive physical contests, it also includes that more peaceful competition by which certain favourably endowed individuals manage to come in for more than their share of the good things of this life, leaving a scanty supply for their less favoured brethren. The author in the very next chapter ascribes great importance to "Climatic Influences" in the production of variation, and justly, and in the above instance he hints that the differences between the two species referred to are due to such causes. But how can any one, in the present state of our knowledge, venture to declare that even the smallest colour-variation produced under the influence of a change of climate is of *no* advantage to its possessor?

We have already devoted so much space to this book that the next three chapters must be passed almost *sub silentio*. The phenomena referred to in them are all recognized factors in the process called "Natural Selection," although the author, in his chapter on "Sexual Selection," seems to regard the latter as a process distinct from Natural or "Protective" Selection.

In his last chapter, on "Interbreeding or Intercrossing," Mr. Dixon enters upon a question of much interest, and one the investigation of which seems to promise very interesting results. He distinguishes three kinds of interbreeding, namely:—1, interbreeding amongst the individuals of a species; 2, interbreeding between subspecies, local races, and representative forms; and 3, interbreeding "which, by absorbing a closely allied form, gradually works the extinction of a species." The first kind of interbreeding, of course, tends to the effacement of small variations and to keep the individuals true to the species (or variety): the second is of special importance to the student of geographical distribution, as it leads to the production of chains of intermediate forms uniting two or more types which may have arrived at the dignity of true species, and its consideration may serve to explain some difficult problems in the distribution of species; while the third is of still greater interest, as it may furnish a clue to the explanation of other still more obscure cases. The particular instance cited by the author is that of the three species of Blue Titmice—*Parus cœruleus*, *P. cyanus*, and *P. Pleskii*. The first of these species, the common Blue Titmouse, is restricted to Europe; the second inhabits Eastern Russia and Siberia as far as the Pacific; while the third is found in Central Russia; this last interbreeds with both the others, and is gradually being absorbed by them. "It would appear," says Mr. Dixon, "that these three species of Blue Titmouse are modifications of a common parent form by Isolation: but as their areas of distribution again became continuous, the two dominant races have intercrossed

with the central form, which is numerically far their inferior and very restricted in its range. The differences developed in this local central form during the period of Isolation are being slowly absorbed by Interbreeding, now that the Isolation has ceased; and the race which would probably have firmly established itself and spread east and west, had it not encountered on either hand a bar to its progress in the two more flourishing, stronger, and wider-ranging forms, is being worsted in the struggle with them, and is slowly but surely passing away." It is easy to see that there are weak points in this argument, but the facts are in themselves interesting and seem to open up a line of inquiry which may lead to most valuable results.

In the earlier part of this notice we have felt compelled to dissent from the interpretation put by Mr. Dixon upon the now classical term "Natural Selection," and to indicate that, while he is free from that semi-superstitious veneration for it which seems to lead many enthusiastic disciples of Mr. Darwin to regard the phrase as something akin to the unintelligible words employed by the sorcerers of former days to banish demons into the Red Sea or a hotter locality, and as serving to settle all matters in dispute and consign their opponents at once to a limbo intellectually almost equally disagreeable, he has himself made a mistake in the opposite direction, and thus been led to undervalue the theory established by the greatest naturalist of our day. The fact appears to be that the author has altogether misunderstood the sense in which Darwin employed the word "Selection." Thus he says (p. 54), "Sexual Selection does not depend on taste alone, although it may seem a misnomer to so entitle such a means of modification if *choice* is not the exclusive agent employed;" but we find a glimmer of better things in the statement, that "the term Sexual Selection is so well known that it would be unwise to change it; but it must always be borne in mind that it is used in a very broad sense,"—that is, we presume, in a sense consistent with the general theory of Natural Selection. Nevertheless he has just previously stated that "Darwin placed too much confidence in Natural Selection and far too little in Sexual Selection."

But in the various sections of his book, in which he bases his arguments exclusively upon ornithological data, he has brought together a mass of most valuable detailed observations upon the variations of birds in connexion with their geographical distribution, and his remarks upon these will be found very interesting and valuable for the student of ornithology. At present, when the idea of absolute fixity of species has been given up by almost all naturalists, the question of the claims of particular forms to specific rank has become one of great difficulty; and every contribution, such as this little book affords, towards the unravelling of the web of doubts and queries in which the feet of the student of systematic zoology and of the range of species are entangled at every step must be welcome. From this point of view we can conscientiously recommend Mr. Dixon's book to the notice of his fellow workers.

MISCELLANEOUS.

Remarks on the Occurrence of Diplommatina *in Trinidad.* By R. J. Lechmere Guppy *.

About twenty years ago Mr. Thomas Bland, F.G.S., of New York, informed me that a land-shell of the genus *Diplommatina* had been found by Mr. Theodore Gill in Trinidad. The locality of its occurrence (I believe he only obtained a single example) was a spot near the Maracas waterfall. On search I succeeded in finding at first a few, and afterwards more numerous examples. I also found the shell in other parts of the island, but never in any place unless a portion of undisturbed forest occurred there.

The shell in question was considered by Pfeiffer to be *Diplommatina Huttoni*. The original *D. Huttoni* was found on the lower slopes of the Western Himalayas, its range extending at the outside not more than two or three hundred miles along the base of the mountains. This shell has never been found in any other locality. Some doubts have arisen as to the actual specific identity of the Trinidad shell and that from the Himalayas; and hence in 1872 I proposed the name *occidentalis* for our species. The question was taken up and very ably treated by Mr. Blanford in 1868.

In 1881, Mr. Sylvester Devenish, late Surveyor-General of Trinidad, forwarded to me for examination a specimen of rock from Punta Gorda, a peninsula on the southern side of the north-western arm of Trinidad. This peninsula juts out into the Gulf of Paria, and is about two miles long by less than half a mile wide.

Mr. Devenish's account of the specimen forwarded by him is as follows:—"I got it by breaking a curious hollow piece of limestone coming from one of the western points of Point Gourd." The specimen in question is a light red or pinkish breccia, consisting of pieces of limestone and shells cemented together by calcareous matter. The shells are numerous and in good preservation, but difficult of extraction, the matrix being hard and the shells brittle. The shells are referable to the following species:—

Stenogyra octona, Chemn.
Cylindrella trinitaria, Pfeiff.
Helix bactricola, Guppy.
Cistula aripensis, Guppy.
Helicina nemoralis, Guppy.
Diplommatina occidentalis, Guppy.

It is specially the occurrence of the latter shell which lends a peculiar interest to the discovery made by Mr. Devenish.

The assemblage of shells noticed above, as found in the cave breccia of Punta Gorda, is such as (with the exception of the *Stenogyra*) is found in the recesses of our northern mountains, such as Aripo and Oropuche, at an elevation of from two thousand to three thousand feet, and not elsewhere. These mountains are covered with

* From the 'Proceedings of the Scientific Association of Trinidad.' Communicated by the Author.

the original forest; they are uninhabited, and rarely trodden except by the hunter. In such places only have I ever met with *Helix bactricola*, *Cistula aripensis*, or the *Diplommatina*; and they do not now exist on Punta Gorda, or anywhere in its neighbourhood so far as I have been able to ascertain. Punta Gorda is practically an islet, being cut off from the main island of Trinidad by a mangrove swamp submerged at high water. Through this swamp a canal was cut some thirty or forty years ago, connecting the water of the Gulf on each side of the peninsula. Punta Gorda is similar in its structure to the islets in its neighbourhood—namely, the Cotoras, Careras, and Gaspari; it is composed of compact limestone of Devonian or Carboniferous age, in which exist caverns and fissures, and in these caverns and fissures are deposited stalagmitic matter, sometimes forming a breccia-like stone.

Of the probable antiquity of the breccia in which the shells are imbedded, it is difficult exactly to judge. The destruction of the original forest upon Punta Gorda possibly induced not only a slackening of the formation of stalagmites, but also involved the extinction of some of the land-shells. The molluscan fauna of the peninsula at present consists of *Stenogyra octona*, *Helicina barbata*, *H. lamellosa*, *Cyclotus translucidus*, *Cylindrella trinitaria*, and *Bulimus pilosus*—an assemblage having only two species in common with the cave deposit. Punta Gorda, as well as the islets near it, and the Boca Islands were cultivated at the beginning of the century, and crops of cotton were raised there. It is not likely, therefore, that the breccia containing shells is less than fifty or sixty years old; while, on the other hand, it is more probable that its age might be reckoned in hundreds of years. Ships arrived here from India for the first time in 1845.

I think, therefore, that the evidence now given tends to strengthen the theory that the *Diplommatina* is an aboriginal inhabitant of the island, and was not introduced from India.

Mr. Blanford has already pointed out that the distribution of the Cyclophoridæ (including *Diplommatina* and its allies) includes, besides certain other countries, India and the West Indies. In my paper in the 'Zoological Proceedings,' 1875, p. 318, I have pointed out several analogous circumstances as regards geographical distribution, especially, for instance, that of *Streptaxis*.

Globiferi, new Organs of the Echinida. By Dr. OTTO HAMANN.

On the skin of many Echinida, besides spines, pedicellariæ, and sphæridia, certain organs occur which have hitherto remained undiscovered. On account of their peculiar form I call them *globiferi*.

Upon a movable peduncle, sometimes long, sometimes short, are seated some globular bodies, which may show the most multifarious structures in different species. In *Sphærechinus granularis* the head of the globifer consists of three spheres united to each other at their points of contact, and each of which shows an aperture, generally of a circular form, even under a low power. In the peduncle of

each globifer there is a calcareous rod which serves to support the head.

Globiferi are distributed over the whole surface of the skin. They occur on both the ventral and the dorsal surface. In size they measure a few millimetres. They occur in most Echinida. As yet I have examined them most accurately, besides *Sphærechinus*, in *Centrostephanus longispinus*, Peters. In this latter species the structures seated upon the peduncle are of ovate form.

The investigation of fresh globiferi, separated from the living animal, shows at once that they are glandular organs which emit a secretion through apertures. The tightly stuffed glands (each globule contains a gland with its aperture) may be easily brought to immediate evacuation; this takes place particularly on the addition of Flemming's chrom-osmium-acetic acid. The evacuation is effected by means of a well-developed musculature. The muscular fibrillæ (smooth muscle-cells) run concentrically with the aperture of each glandular ball.

The structure of those glandular balls is complex, and varies in the different genera and species. According to the state in which the gland is its structure differs. It reminds one strikingly (especially in *Centrostephanus*) of the conditions presented by the mucigenous cells of the Vertebrata in the resting state, or in active secretion.

Neither the Holothurians nor the Asterida possess any organs like the globiferi. In them the gland-cells are distributed in the skin, the epithelium. If this were the case in the Echinida, any action of theirs against enemies would be inconceivable, as the long spines must hinder any such action. Glandular organs will be capable of cooperating with the stalked pedicellariæ in defence only when attached to peduncles. And that we must regard the globiferi as defensive organs, weapons, and as acting in the same way as the nettle-capsules of the Cœlenterata, is indicated by their structure and by observations on the living animal.—*Sitzungsberichte der Jenaischen Gesellschaft für Medicin und Naturwissenschaft*, 1886.

Some new Infusoria from American Fresh Waters. By Dr. Alfred C. Stokes.

In the paper on this subject by Dr. Stokes in the 'Annals' for February of the present year, at p. 104, a new genus is characterized under the name of *Diplomastax*. In Dr. Stokes's MS. the name given to this genus was *Diplomestoma*, the etymology of which was given by him as follows:—"διπλόος, double; ὑμήν, a membrane; στόμα, a mouth;" from which it seemed to the Editors absolutely impossible to get such a word as *Diplomestoma*. While hesitating whether to change the name, and if so how to change it, the Editors found that in the explanation of the figures the species described stood as *Diplomastax frontata*; and the latter name was accordingly adopted, under the impression that Dr. Stokes had

either intended to substitute it for the other, or that he had been balancing between the two and had unfortunately chosen to adopt the bad one.

Dr. Stokes now writes to say that the name *Diplomastax* (which was no doubt at first adopted by him for his genus) is preoccupied among the Flagellate Infusoria, and to request that his name *Diplomestoma* may be substituted for it as that of the genus in question.

Striated Muscles in Echinida. By Dr. Otto Hamann.

While transversely striated muscles are known in many groups of the lower animals, hitherto only smooth muscular fibrillæ have been known in the Echinodermata. In Holothuriæ and Asterida I have sought in vain for transversely striated fibres *, but I have now succeeded in finding them in the Echinida. They occur, however, only in a few places, and, indeed, in places where a sudden, rapid, and energetic contraction has to take place. The largest forms of pedicellariæ, the *pedicell. tridentes* s. *tridactyles*, are best fitted for examination.

The musculature which moves the three arms consists of parallel fibrillæ, which, if examined in the living state, distinctly show the transverse striation. The individual fibrillæ may be easily separated from each other, and then it appears that each fibril has attached to it externally a large, elongate oval nucleus, which is situated about in the middle of the fibril. It is but rarely that any plasma is still demonstrable around this. If it be pulled to pieces in picro-carmine and afterwards examined in glycerine, the lighter and darker transverse striæ, and, in the former, Krause's transverse disks, make their appearance distinctly, as also the thin sarcolemma. The diameter of the nearly cylindrical fibrillæ is about 0·0028 millim.; their length in the pedicellariæ of *Centrostephanus longispinus*, Peters, is between 0·5 and 0·6 millim.

Now and then we may detect a longitudinal striation in the fibrillæ; and when treated with various liquids, each fibril breaks up into a number of exceedingly fine parallel elements (I counted 4–6) which still show the transverse striation distinctly.

The species which I have been able to examine, in which transversely striated musculature exists, are as follows:—*Centrostephanus longispinus*, Peters; *Dorocidaris papillata*, A. Agass.; *Arbacia pustulosa*, Gray; *Strongylocentrotus lividus*, Brandt; *Sphærechinus granularis*, A. Agass.; *Echinus acutus*, Lam.; *Echinus melo*, Lam.; and *Echinus microtuberculatus*, Blainv.—*Sitzungsberichte der Jenaischen Gesellschaft für Medicin und Naturwissenschaft*, 1886.

* Hamann, 'Beiträge zur Histologie der Echinodermen: Heft 1. Die Holothurien; Heft 2. Die Asteriden anatomisch und histologisch untersucht' (Jena, 1884-85).

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XXXIV.—*On a new Genus of Devonian Corals, with Descriptions of some Species of the same.* By H. ALLEYNE NICHOLSON, M.D., D.Sc., Regius Professor of Natural History in the University of Aberdeen; and ARTHUR H. FOORD, F.G.S., late of the Geological Survey of Canada.

[Plates XV. & XVI.]

THERE occur in the Devonian formation of both Germany and Britain certain types of Corals which have a close resemblance in general aspect to the species of the genus *Chætetes*, Fischer. In some regions, as in the Middle Devonian of the Rhine, these corals are sometimes very abundant. This is the case with the singular coral described by Prof. Ferd. Roemer under the name of *Chætetes stromatoporoides* (Leth. Palæoz. p. 459, fig. 111). An allied form has been described by Prof. Schlüter under the name of *Calamopora crinalis*. To the same group must also be referred the coral described from the Devonian rocks of Devonshire by Mr. Etheridge, Jun., and one of the present writers under the name of *Chætetes Lonsdalei*. Having recently had the opportunity of making a microscopical examination of a very extensive series of these forms, we have satisfied ourselves that they cannot be referred to the genus *Chætetes*, Fischer; and, indeed, that they exhibit characters which distinguish them from any clearly defined genus with which we are acquainted. We propose therefore to found for their reception the new genus *Rhaphidopora*, with the following characters:—

Genus Rhaphidopora, Nich. & Foord.

Corallum variously shaped, but mostly encrusting, or in other cases massive. Corallites all of one kind, polygonal, in close apposition, the walls of contiguous tubes being confluent. Walls of the corallites imperforate. Calices polygonal. Tabulæ numerous, horizontal. Septal spines variably developed, but always present, and consisting of conical tooth-like projections, which extend only a short distance into the visceral chambers of the corallites, and are not arranged in regular vertical rows. Increase by gemmation.

Type: *Rhaphidopora crinalis*, Schlüter, sp.

Rhaphidopora crinalis, Schlüter, sp.
(Pl. XV. figs. 1–3.)

Calamopora crinalis, Schluter, Sitzungsberichte der niederrheinischen Gesellschaft in Bonn, 1881, p. 281.
Chætetes Lonsdalei, Eth., Jun., & Foord, Ann. & Mag. Nat. Hist. 1884, vol. xiii. p. 474, pl. xvii. figs. 2–2 *c*.

Spec. char. Corallum sometimes encrusting, sometimes laminar, sometimes massive, the latter being probably the typical adult condition. Corallites polygonal, with completely coalescent walls, averaging about $\frac{1}{3}$ millim. in diameter, but with dimensions in some specimens slightly larger or smaller than this. Tabulæ are well developed, horizontal, and about $\frac{1}{3}$ to $\frac{1}{7}$ millim. apart. The walls of the tubes are not specially thickened, and often exhibit dark transverse lines, which seem to connect adjoining visceral chambers, and which look like mural pores filled up with some dark material. These cross bars will be subsequently shown, however, to be due to mineralization, and the walls are in reality imperforate. Septal spines are variably developed, but are present in all well-preserved examples, and have the form of strong tooth-like projections, which extend a short distance into the visceral chamber, and which, however numerous, are not arranged in regular vertical rows.

Obs. This species is very variable in its mode of growth, but its adult form seems to be usually that of a spheroidal or pyriform mass. We have examined a large series of specimens, most of which are from the Middle Devonian of Germany, and which, like most of the more delicate corals from this region, have undergone a good deal of change in the process of mineralization. Hence there are various points in the structure of the species which it is difficult to account for with absolute certainty. In tangential sections of *R. crinalis* Pl. XV. figs. 1, 2, and 3) the most striking feature is the

presence in the corallites of a variable number of strong tooth-like projections, which extend a short distance inwards into the visceral chamber. Sometimes there may be only one of such projections visible in a given corallite, or there may be several. When only a few of these structures are present they have a close general resemblance to the curious inward projections of the walls which characterize the genus *Chætetes*, Fischer. In the latter, however, these projections are undoubtedly the result of the fission of the tubes. On the other hand, in *R. crinalis* they are of a different nature, being incontestably of the character of septal spines. That this is their true nature is conclusively shown by the fact that they are not only, on the whole, far more numerous than are the apparently similar projections in *Chætetes*, but a single corallite may have four or five or more of such teeth exhibited in transverse section, a condition which would be impossible if they were due to fission of the tubes. These tooth-like projections, in fact, bear a marked resemblance to the peculiar septal spines of the so-called *Alveolites Battersbyi*, E. & H.

A more difficult point to be assured of is, as to whether or not mural pores are present in *R. crinalis*. This problem was decided in the affirmative by Prof. Schlüter, upon the ground that the walls of the corallites commonly exhibit dark transverse bars, as seen in tangential sections, and that such bars must be mural pores filled up with matrix. Similar transverse bars intersecting the walls of the corallites in tangential sections are seen in all the species of *Rhaphidopora* which have come under our notice, and they are sometimes very numerous and very regular in their distribution and arrangement. At first sight, they certainly present a resemblance to mural pores filled up by some dark material; but there are several reasons of a general nature from which it must be concluded that this cannot be their true constitution. Thus, it is incredible that these transverse markings should be so numerous as they often are in the species of *Rhaphidopora* if they are really due to mural pores; since in tangential sections of species of *Favosites*, *Alveolites*, and *Michelinia*, in which mural pores are well known to exist, it is a comparatively unusual thing to find them in transverse sections of the tubes. Again, it is in the highest degree improbable that these markings should be due to mural pores, and that no traces of the existence of such apertures should be capable of detection in *longitudinal* sections of the corallites of *Rhaphidopora crinalis*. We have, however, never succeeded in demonstrating their presence in vertical sections of this or of any other species of *Rhaphidopora*, and are satisfied that they do not exist.

We shall further be able to show, in dealing with *R. stromatoporoides*, that these transverse markings in the walls of the corallites are not of organic origin at all. Both transverse and longitudinal sections of *R. crinalis* show that the walls of the corallites are in no way specially thickened, and the visceral chambers remain therefore distinct. Tabulæ (Pl. XV. figs. 2 *a*, 3 *a*) are numerous, horizontal, and complete.

The nearest ally of *R. crinalis* is *R. stromatoporoides*, Roem., sp.; but the latter has on the average tubes of a decidedly smaller size (averaging from $\frac{1}{5}$ to $\frac{1}{4}$ millim. in diameter). At the same time it is to be noted that in neither of these species are the corallites of an invariable size, since examples of *R. crinalis* occur with tubes below the average size, while specimens of *R. stromatoporoides* are found with corallites of greater than the average dimensions. In such cases it is difficult to decide positively to which of the two species a given specimen belongs. As a rule, however, the corallites in *R. stromatoporoides* are not only decidedly smaller than they are in *R. crinalis*, but their walls are mostly thicker and their visceral cavities are more rounded, while peculiar rounded tubercular structures, the nature of which is not quite clear, are often developed at the angles of junction of contiguous corallites.

Formation and Locality. Common in the Middle Devonian of Sötenich and Gerolstein, in the Eifel. We have also found it at Büchel (in the Middle Devonian of the Paffrath district). Professor Schlüter's specimens were collected in the Middle Devonian rocks of the Hillesheim basin, in the Eifel. We have also examined specimens belonging to this form from the Middle Devonian of Devonshire (Teignmouth, Bishopsteignton, and Torquay).

Rhaphidopora crinalis, Schlüt., var. *aculeata*, Nich. & Foord.
(Pl. XV. figs. 4–4 *b*.)

Corallum laminar and encrusting, the corallites of decidedly larger size than is usual in *R. crinalis*, and being also of a more compressed and elongated form. The tubes vary in diameter from about $\frac{2}{5}$ millim. to $\frac{1}{2}$ millim. The walls of the corallites are not thickened and are furnished with very numerous tooth-like septal spines, which project a short distance into the visceral chambers. No signs of mural pores can be detected unless the occasional occurrence of dark transverse bars crossing the walls of the corallites in tangential sections be taken as indications of the presence of such openings; but these, as in *R. crinalis*, must we think be

interpreted to be the result of mineralization. The tabulæ are numerous, complete, and about $\frac{1}{3}$ millim. apart.

This hardly seems to be more than a well-marked variety of *R. crinalis*, Schlüt. It is distinguished by the larger average size of its corallites and their more compressed form, and, above all, by the extraordinary development of the septal spines. These structures are not only exceedingly numerous (Pl. XV. fig. 4 *a*), but they can be readily recognized in longitudinal sections of the corallites as well as in tangential ones. In sections of the former kind (Pl. XV. fig. 4 *b*) they are shown as strong, upwardly-directed, tooth-like spines developed from the walls of the corallites, and their cut ends are also seen as dark circular spots (which must not be mistaken for mural pores) in the cavities of the tubes themselves.

Formation and Locality. Middle Devonian, Gees, near Gerolstein, in the Eifel.

Rhaphidopora stromatoporoides, Roemer, sp.
(Pl. XV. figs. 5–7 *a* and Pl. XVI. figs. 1–7.)

Chætetes stromatoporoides, Ferd. Roemer, Lethæa Palæozoica, p. 459, fig. 111 (1883).
Pachythera stellimicans, Schluter, Sitzungsberichte der niederrheinischen Gesellschaft in Bonn, 1885, p 144.
Calamopora piliformis, Schluter, *ibid*. p. 144 (footnote).

Spec. char. Corallum laminar, most commonly composed of successive colonies of varying thickness, and very often attached by the whole of the inferior surface to some foreign body. Corallites polygonal, in close contact, with coalescent walls, averaging from $\frac{1}{8}$ to $\frac{1}{4}$ millim. in diameter, but sometimes falling below or exceeding these dimensions either wholly or in part. Walls of the corallites moderately thickened, the primordial wall being occasionally visible as a thin dark line in the centre of the apparently single wall separating the visceral chambers of adjoining corallites (Pl. XVI. fig. 1 *b*, upper part). The visceral chambers of the corallites may be filled with clear crystalline calcite (as usual), with the tabulæ intact; but in many cases they are more or less extensively encroached upon by a darker matrix, and the walls and the tabulæ obliterated by the development of a peculiar structure, which we shall subsequently show to be of a purely inorganic nature. At the angles of adjacent corallites are often developed peculiar tubercular thickenings, the nature of which is not apparent. Tabulæ are numerous and horizontal, mostly from $\frac{1}{8}$ to $\frac{1}{6}$ millim. apart. Septal spines are variably developed, but usually less numerous than in *R. crinalis*. Walls imperforate.

Obs. As regards the mode of growth in this form, the corallum not unfrequently consists of a single layer of corallites, perhaps ½ to 1 centim. in thickness, and forming an expansion of some inches across. In such a case the corallum may have a basal epitheca or it may be cemented down to some foreign body *. In a great many examples the corallum consists of a number of successively superposed layers or colonies, which may be all alike or which may differ from one another in certain apparently structural features. Sometimes these successive layers are obviously only the result of progressive interruptions in the growth of a single corallum, just as is seen in many other corals. In other cases the successive layers are separated by a complete interruption of continuity, a minute interval, represented by a delicate layer of mineral matter, existing between each pair of contiguous corallites. In such cases, provided the successive layers are all alike in structure, we see no reason to doubt that they belong to a single species and are the result of the growth of a number of successive generations one above the other. Precisely the same phenomenon is to be seen in many Stromatoporoids, in which the cœnosteum consists of a number of "latilaminæ," which may be separated from one another in places by more or less complete breaks or intervals.

In other specimens the fossil not only consists of a number of superimposed layers or colonies, but one or more of these layers may present appearances very different from the rest, the nature of which will be subsequently explained. In such cases it is natural to suppose that the differing layers belong to different *species*. Thus it is very common to meet with specimens composed of one or more layers of corallites which are distinguished by having their visceral chambers occupied by clear calcite and their walls and tabulæ distinct, together with one or more layers in which the visceral chambers are more or less completely obliterated by the removal of the tabulæ and the walls undiscernible.

Professor Schlüter has regarded such cases as the result of the parasitism of one species upon another distinct species. Hence he has called the layers with normal corallites and visceral chambers *Calamopora piliformis*, and he has given the title of *Pachytheca stellimicans* to the layers in which the corallites have their walls and visceral chambers more or less extensively effaced in a manner to be subsequently described and explained.

The observations we have made upon a very extensive

* It occurs very commonly growing upon the laminar cœnosteum of *Stromatoporella eifelensis*, Nich.

series of such specimens as those above mentioned have led us to the conclusion that they consist, as a general rule at any rate, of two or more colonies of a single *species* in different states of preservation.

The principal grounds of a general nature upon which we base this conclusion are as follows:—

(1) Very many specimens are composed of successive layers, which may or may not be separated by complete interruptions of their continuity, but which must belong to a single species, as being throughout identical in structure.

(2) When successive colonies differ in apparent structure, they for the most part agree nevertheless in the size of the corallites, and they only differ as to the extent to which the walls and visceral cavities of the corallites have been obliterated by the induction of a peculiar secondary alteration, which we shall show to be due to mineralization.

(3) In the few instances in which the tubes in successive colonies not only differ in apparent structure, but also in size, the latter difference is not greater than often obtains in different parts of a single layer, or of successive layers which otherwise agree in every respect.

(4) In these composite specimens the different layers are all precisely conterminous, each being applied to the entire surface of the layer below. If, however, we were dealing with a case of the parasitism of one species upon another, we could not fail to meet with specimens in which the parasite would only *partially* envelop the organism upon which it grew.

We consider then that the differences in apparent structure above alluded to constitute an *individual* and not a *specific* character, and we shall consider the nature of this character immediately. Before doing so, however, it is advisable to make some remarks upon the size of the tubes in the present species. The diameter of the corallites is a point to which Schlüter assigns a specific value, and upon which he lays considerable stress. Thus he assigns 20–22 tubes in a square millimetre to *Calamopora piliformis*, Schlüt., this corresponding roughly with a diameter of between $\frac{1}{4}$ and $\frac{1}{5}$ millim. to the individual corallites. *Calamopora stromatoporoides*, Roem., is said to have 30–40 tubes in a square millim., which would give a rough average of from rather less than $\frac{1}{5}$ to rather more than $\frac{1}{6}$ millim. *Calamopora crinalis*, Schlüt., is stated to have 14 tubes to the square millim., which would give a diameter of rather less than $\frac{1}{3}$ millim. to the individual corallites. Lastly *Pachytheca stellimicans*, Schlüt., is stated to have 12–15 tubes to the square millim., or a diameter of between $\frac{1}{3}$ and [illegible] millim. to each tube.

Our observations have extended over a very large series of specimens, and have led us to conclude that the size of the tubes is an exceedingly variable character. That the tubes of *R. stromatoporoides*, Roem., are on an average decidedly smaller than those of *R. crinalis*, Schlüt., is undeniable; and hence this character is one very serviceable in the discrimination of specimens of these two forms. On the other hand, there are individual specimens, not otherwise separable from the type of *R. crinalis*, which have tubes considerably smaller or larger than the average of the species. In the same way there are individuals of *R. stromatoporoides*, Roem., with tubes decidedly larger than is usual in the species, while others have tubes below the ordinary standard of width. Hence there are specimens which it is difficult to definitely refer to either the one species or the other. Moreover, we find that the size of the corallites is not necessarily or always constant even in a single individual. In the case of *R. stromatoporoides*, in particular, we find that a single specimen, or even a single slide, may show in different parts precisely the same variations in the sizes of the tubes which Professor Schlüter relies upon for separating his *Calamopora piliformis* from *R. stromatoporoides*, Roem. We are therefore of opinion that, except within certain restricted limits, the dimensions of the corallites in these corals cannot be safely trusted to as a means of discriminating species.

The most interesting feature in connexion with *R. stromatoporoides*, Roem., is, however, the extraordinary variations exhibited by different individuals of the species as to the condition of the visceral cavities and walls of the corallites. These variations form a connected series, of which the following are the two extreme terms:—

(A.) In one set of specimens the visceral chambers of the corallites are filled only with clear calcite, and the walls of the tubes remain perfectly distinct. Such specimens also have the tabulæ and septal spines well developed (Pl. XV. figs. 5–5 *b*, 6, 6 *a*, 7, 7 *a*). These examples closely resemble *R. crinalis*, Schlüt., in their main structural features; but their tubes are on the average decidedly smaller than those of the latter species. Thus the corallites of *R. crinalis* have an average diameter of $\frac{1}{3}$ millim., whereas the corallites of the forms here under consideration are between $\frac{1}{4}$ and $\frac{1}{5}$ millim. in diameter.

Judging from the short description given, we should say that it is upon specimens of this group that Professor Schlüter has based his *Calamopora piliformis* (*loc. cit. suprà*), and we may therefore provisionally speak of such as "*piliformis*"

specimens. Sometimes the entire specimen may be in the above condition, and may consist of several superposed colonies; in other cases the specimen may consist of one (sometimes more than one) colony in this condition, and of one or more colonies in the following state.

(B.) In a second group of specimens the axes of the visceral chambers are represented by dark lines, from which proceed slender also dark radii, the walls of the corallites being at the same time more or less completely obliterated, the septal spines being no longer recognizable, and the tabulæ having almost or quite disappeared. Specimens in this condition can be readily recognized by the possession of a characteristic dark-brown or black colour on broken surfaces, together with the possession of a crystalline texture and an almost conchoidal fracture.

Tangential sections of such examples (Pl. XVI. fig. 2) show appearances which are at first sight very similar to what is seen in corresponding sections of Stromatoporoids belonging to the genus *Actinostroma*, Nich. The general ground-mass of the section is, however, composed of a translucent structureless or obscurely fibrous horn-like material, of a brown colour, not clearly exhibiting the walls of the corallites, and showing no light spaces filled with calcite, such as would represent the cavities of the tubes. The section, on the other hand, exhibits a number of dark stars, usually with six rays each, and these stars become united regularly by the union of their rays, so as to give rise to a kind of "hexactinellid" structure. The centre of each of these dark stars represents, as will be seen, the centre of a visceral chamber, and each star therefore corresponds with a single corallite.

Vertical sections of specimens belonging to the group now under consideration present the same translucent, horn-like, brown aspect (Pl. XVI. fig. 1 *c*, or the upper half of fig. 6). The most conspicuous feature in such sections is the presence of parallel vertical dark lines, which *look* like the walls of the corallites, but which really represent the axes of the visceral chambers. Midway between each pair of these dark lines we may often recognize much fainter lines, which indicate the position of the true *walls* of the corallites. The entire ground-mass of the section has more or less conspicuously a characteristic fibrous or semicrystalline aspect; and we may here and there recognize the position of one of the tabulæ (Pl. XVI. fig. 1 *c*, *t*).

The appearances just described were regarded by Professor Schlüter as being of an organic nature, and he hence referred the group of specimens here in question to a new genus and

species under the name of *Pachytheca stellimicans* (Sitzungsberichte der niederrhein. Gesellsch. in Bonn, 1885). Even on the supposition that these appearances *are* organic, we should be unable to accept this name, either as regards the species or the genus, since it can be shown conclusively that the *species* is the *Chætetes stromatoporoides* of Roemer *, while the name of *Pachytheca* has been preoccupied by Sir Joseph Hooker for certain problematical bodies from the Ludlow rocks of Britain †.

EXPLANATION OF THE PLATES.

Plate XV.

Fig. 1. Tangential section of *Rhaphidopora crinalis*, Schluter, enlarged twelve times. The section is taken from the type-specimen of *Chætetes Lonsdalei*, Eth., Jun., & Foord, and is from the Devonian of Teignmouth.

Fig. 1 *a*. Vertical section of the same, similarly enlarged.

Fig. 2. Tangential section of a specimen of *Rhaphidopora crinalis*, Schlut., from the Middle Devonian of Sotenich, in the Eifel, enlarged twelve times. The tubes are somewhat larger than in the typical examples of *R. crinalis*; but this would not appear to be a difference of specific value.

Fig. 2 *a*. Vertical section of the same, similarly enlarged.

Fig. 3. Tangential section of a specimen of *Rhaphidopora crinalis*, Schlut., from Gerolstein, in the Eifel, enlarged twelve times. In this specimen, as in the preceding, the tubes are somewhat larger than in typical examples of the species.

Fig. 3 *a*. Vertical section of the same, similarly enlarged.

Fig. 4. Tangential section of *Rhaphidopora crinalis*, Schlut., var. *aculeata*, Nich. & Foord, enlarged twelve times. Middle Devonian, Gerolstein.

Fig. 4 *a*. Part of the same section, enlarged twenty-four times. The dark transverse bars visible here and there, crossing the walls of the tubes in tangential sections, are not due to the presence of mural pores, but seem to be the result of mineralization.

Fig. 4 *b*. Vertical section of the same, enlarged twenty-four times. *s*, the cut extremity of one of the septal spines.

Fig. 5. Tangential section of a specimen of *R. stromatoporoides*, Roem., in which the visceral chambers are open and the walls distinct, enlarged twelve times. Middle Devonian, Gerolstein.

Fig. 5 *a*. Part of the same section, enlarged twenty-four times, showing the septal spines.

Fig. 5 *b*. Vertical section of the same specimen, enlarged twelve times. In the upper portion of the section destructive infiltration has set in, and the visceral chambers are partially obliterated.

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* We have examined an example of *R. stromatoporoides* kindly sent us by Professor Roemer himself.

† Quart. Journ. Geol. Soc. vol. ix. p. 12 (1853); *ibid.* vol. xvii. p. 162 (1861).

Fig. 6. Tangential section of an example of *R. stromatoporoides*, Roem., in which the visceral chambers and walls are nearly normal, enlarged twelve times. The tubes are slightly below the average size. Middle Devonian, Teignmouth.

Fig. 6 *a.* Vertical section of the same, similarly enlarged.

Fig. 7. Tangential section of a specimen of? *R. stromatoporoides*, Roem., in the normal condition, the tubes being of slightly larger than average size, enlarged twelve times. Middle Devonian, Gerolstein.

Fig. 7 *a.* Part of the same section, enlarged twenty times, and showing the walls in a mineralized condition.

Plate XVI.

Fig. 1. Tangential section of *R. stromatoporoides*, Roem., taken close to the surface of the specimen, enlarged twelve times. In part of the section figured the visceral cavities are filled with the matrix, but in parts stellate crystallization has taken place, and the walls and visceral chambers are largely obliterated.

Fig. 1 *a.* Part of a tangential section of the same specimen, enlarged twelve times. Owing to infiltration and crystallization the walls of the tubes appear thickened and the visceral chambers are partially obliterated. Curious rounded tubercles are also seen at the angles of junction of the corallites.

Fig. 1 *b.* Part of another slide of the same specimen, enlarged twenty times. The tubes are partly filled with matrix and show distinct walls (sometimes with traces of the primordial wall). In other parts of the section the tube-cavities and walls are largely obliterated by stellate crystallization.

Fig. 1 *c.* Vertical section of the same specimen, enlarged twelve times. The dark vertical lines (*v*) represent the axial lines of the tube-cavities; but in places portions of the visceral chambers are not infiltrated with the darker destructive material, and still exhibit tabulæ (*t*).

Fig. 2. Tangential section of *R. stromatoporoides*, Roem., in the typical "*stellimicans*" state, enlarged twelve times. The visceral chambers and walls are completely obliterated by stellate crystallization. Middle Devonian, Gerolstein.

Fig. 2 *a.* Part of another tangential section of the same specimen, enlarged twenty times. In this part of the section the tubes are much below the average size. On the right hand side of the figure the stellate crystallization is completely developed; but towards the left the visceral chambers are not infiltrated with the darker material. The walls are obliterated throughout.

Fig. 3. Part of a tangential section of *R. stromatoporoides*, Roem., enlarged twenty times. The walls of the corallites are still quite recognizable, but the visceral chambers are occupied by stellate crystallization, the fibres of which strike through the walls and give to the latter the aspect of being crossed by transverse dark bars. Middle Devonian, Gerolstein.

Fig. 4. Vertical section of a double colony of *R. stromatoporoides*, Roem., enlarged twelve times. The lower colony (A) is in the normal state; the upper colony (B) is in the "*stellimicans*" state; and the two are separated by a well-marked interval. In the upper colony the axes of the visceral cavities are marked by vertical dark lines (*v*), and the fainter lines (*w*) between each pair of

these indicate the position of the true tube-walls. Middle Devonian, Gerolstein.

Fig. 5. Part of a tangential section of *R. stromatoporoides*, Roem., enlarged twenty times. The specimen is in the "*stellimicans*" state, but the walls of the tubes are visible. The peculiar rounded tubercles at the angles of junction of the corallites are well seen. Middle Devonian, Gerolstein.

Fig. 6. Part of a vertical section of a double colony of *R. stromatoporoides*, Roem., partly in the normal condition and partly in the "*stellimicans*" state, enlarged twelve times. Middle Devonian, Gerolstein.

Fig. 7. Part of a vertical section of another example of the same, similarly enlarged. In this specimen the stellate crystallization has not been complete, and the centres of the tube-cavities are partially unobliterated and exhibit the remains of the tabulæ. Middle Devonian, Gerolstein.

Fig. 8. Part of the surface of *R stromatoporoides*, enlarged forty times. Minute elevations are seen at the angles of junction of the corallites; but these may be only the result of weathering. Middle Devonian, Gerolstein.

[To be continued.]

XXXV.—*Note on* Orcynus thynnus (*L.*). By Francis Day, F.L.S., F.Z.S.

It is always satisfactory to obtain reliable records of rare or little-known British fishes, especially when new facts have been ascertained as to their geographical distribution, external form or internal structure, &c.; and I was therefore pleased to see in your last month's issue a paper by Dr. M'Intosh on a male tunny (*Orcynus thynnus*), 9 feet long, trawled off Pittenweem, in Scotland. In that paper some criticisms are offered upon my work on 'British and Irish Fishes' and on my figure of the tunny, which observations I propose briefly replying to so far as they affect myself.

But I must first observe that as no figure of this new specimen is given, while the number of fin-rays is omitted, no evidence is offered, except as to the size of the fish, that it was the tunny (*Orcynus thynnus*), or the bonito (*Thynnus pelamys*), or even *T. thunnina*, which has been captured more than once off Denmark. An essential difference between the fishes forming the restricted genera *Orcynus* and *Thynnus* consists in those pertaining to the first having "small teeth on the jaws, *vomer*, and palatine bones," while in the second there are "small teeth on the jaws, palatine bones, but *none on the vomer*." Dr. M'Intosh observes of his example:—"The

mucous surface of the roof of the mouth has, in addition to the rasp-like teeth on the palatines, numerous hardened streaks from thin ossifications of the region" (*l. c.* p. 329). Consequently it would appear that *it did not possess teeth on the vomer.*

I now come to the questions raised respecting my figure, which, as I stated, was from a stuffed example in the national collection, and for stuffed fishes I think those of the tunny will bear comparison with others thus preserved but belonging to different genera; and, while giving this opinion, I may add that I have often seen bonitos and their allies when freshly taken from tropical seas. Premising that I figured the tunny as closely as I was able from the stuffed specimen without indulging in any "fanciful representations," in order to make it more closely resemble what I thought it might look like were it not stuffed, I have re-examined the British-Museum tunny, and with the following results, as any one can verify for himself should he desire to do so. Large specimens in spirit are not in that institution, for thus preserving them would be rather a useless waste of money, which remarks are still further applicable to collections belonging to private individuals.

"The first dorsal fin again is stated to have weak spines. . . . the powerful nature of the first spine is conspicuous" (*l. c.* p. 328). I have shown it nearly twice as wide at its base as the second spine, and that is what exists in the British-Museum specimens, and to it the term "*powerful*" is here quite misapplied. The bonito's is much stronger than that of the tunny; but even it cannot be termed "powerful," for if so how could the first dorsal spines of such fishes as some of the Siluroids be described? In fact I still think that the generic definition of "weak spines" to the tunny fishes as compared with those of other genera is literally correct.

"The premaxillary and maxillary region is too long in the figures of Cuvier and Valenciennes, as well as in Day's" (*l. c.* p. 328). In the largest British example from Weymouth (7 feet $4\frac{1}{2}$ inches from the snout to the base of the tail-fin) the distance from the eye to the end of the snout is $2\frac{4}{5}$ in the length of the head, in a second stuffed specimen 3 feet 1 inch long (computed as above) the length of the snout is just half of the entire length of the head to the postero-inferior end of the opercle, where it joins the subopercle; consequently the length of this portion of the head agrees with that shown in Cuvier and Valenciennes's work, and also with my own figure, but not with Dr. M'Intosh's specimen. The eye is said to be "too large" in my figure; here, again, it

agrees with the specimen. The head "seems to be too long from the tip of the snout to the posterior margin of the operculum" (*l. c.* p. 328); he gives it as about $3\frac{1}{2}$ in the distance to the base of the tail-fin, but I find it to be $3\frac{1}{6}$ in the large specimen and $3\frac{4}{11}$ in the smaller fish, neither measurement agreeing with the Pittenweem example. The teeth are comparatively larger in small than in large examples, and I found them to be about 0·1 inch long in the upper jaw; consequently I do not think they are "*fancifully represented.*"

The spines of the first dorsal fin "seem to have been unusually long anteriorly in the specimen figured by Day" (*l. c.* p. 329). In the largest fish I have referred to the length of the first dorsal spine is $6\frac{15}{29}$ of the length of the fish (to the base of the caudal fin), and of the smaller fish $8\frac{4}{5}$; while it is not quite 8 in my figure. Even Dr. M'Intosh gives the height of the first dorsal as $10\frac{1}{2}$ inches and the length of the fish to the base of the caudal fin at 94 inches. This would be about equal to $8\frac{1}{2}$; and as I do not show it more than 8, I cannot agree to its being "unusually long anteriorly."

Not only does the anal fin in its size, as I have represented it, agree with the specimens, but also in its position, as "a line running vertically from the anterior margin of the anal fin runs behind the second dorsal" (p. 329) in Dr. M'Intosh's specimen, but it does not do so in either of the British-Museum fish.

Dr. M'Intosh, in the Ann. & Mag. Nat. Hist. 1885, xv. p. 433, inserted under the head of *Cottus bubalis* some remarks of mine on the breeding of *C. scorpius*, which I now see he returns to the species under which I originally placed them. Professor Cossar Ewart, in the 'Scotch Fishery Reports,' criticised my figure of *Serranus cabrilla*, and doubted my account of its geographical distribution, asserting that he had obtained it from the north of Scotland; fortunately he figured the specimen, which showed at a glance that it was *Sebastes norvegicus*. Possibly when Dr. M'Intosh's fish is figured it will turn out to be a different fish from the tunny; but if he had looked at the specimens in our national collection before so emphatically condemning my figure, I think he would have satisfied himself that I had only followed nature and the work of the taxidermist, carefully measuring all points and reducing them by the aid of proportional compasses to the size shown in my illustrated work.

XXXVI.—*Notes on the Palæozoic Bivalved Entomostraca.*— No. XXI. *On some Silurian Genera and Species* *. By Prof. T. Rupert Jones, F.R.S., and Dr. H. B. Holl, F.G.S.

[Plates XIII. & XIV.†]

CONTENTS.

In our continued examination of the numerous interesting specimens in the collections made by Messrs. J. Smith and G. R. Vine we find the following genera and species. The same numbers for the various assortments of Wenlock Shales in Mr. Vine's collection are used as in the Ann. & Mag. Nat. Hist., April 1886, namely:—"Shales over the Wenlock Limestone, nos. 24 and 46. Upper Wenlock Shales, nos. 25, 25*, 41, and 42: Tickwood Beds. Middle Wenlock Shales, no. 43: Coalbrook-Dale Beds. Lower Wenlock Shales, nos. 22, 36, 37, 38, 40: Buildwas Beds."

Strepula, gen. nov.

Certain specimens, namely Pl. XIII. figs. 1, 4, 6, 7, 8, and 9, were at first looked upon as belonging to *Kirkbya*, to some forms of which genus (for example fig. 19, pl. iii. Ann. &

* For No. XX. see Ann. & Mag. Nat. Hist. for April 1886, p. 337.

† These Plates have been drawn with the aid of a grant from the Royal Society for the illustration of Fossil Entomostraca.

Mag. Nat. Hist. ser. 5, vol. xv. p. 189) they assimilate, though they want the usual subcentral pit. *K. rigida*, J. & K., *l. c.* fig. 18, is also such a pitless form, and may belong to the same group as these Silurian allies of *Kirkbya*. *K. fibula* (*op. cit.* ser. 4, vol. iii. pl. xv. fig. 9, p. 224), from the Upper-Ludlow beds near Malvern, holds its own as a species of this genus.

The quasi-Kirkbyan specimens here noticed may be grouped under the new generic name of STREPULA *.

The carapace-valves are slightly convex, suboblong, with rounded ends, or semielliptical, that is, less boldly curved at one end than at the other, and bear narrow often trenchant ridges. These are sometimes concentric with the lower margin, in other cases partly concentric and partly irregular. They run into the slightly thickened dorsal margin. The intervening furrows form broad valleys and a subcentral tubercle, or even a lobular swelling is sometimes present. The chief ridge is a free supramarginal lamina, standing outwards and downwards, and hiding the real marginal edge in the side view. The edge view of the bivalved carapace is narrow-ovate, cross-barred at the sides with ridges, some straight and parallel, some oblique and divergent (Pl. XIII. figs. 8 *b*, 9 *b*).

1. *Strepula concentrica*, sp. nov.
(Pl. XIII. figs. 1 *a*, 1 *b*, 4, 6.)

Proportions† : { Fig. 1 : Length 12. Height 7. Thickness 5.
Fig. 4 : Length 19. Height 9.
Fig. 6 : Length 24. Height 11. }

Three concentric but not quite symmetrical narrow ridges are here present (including the supramarginal lamina), sometimes showing a tendency to "sport" or branch, and even to have a connecting isthmus here and there. A small central tubercle is seen in fig. 1 *a*.

This species occurs in Mr. Smith's collection:—no. 11_6, Lincoln Hill, Ironbridge; no. 42, railway-cutting, side of Severn, Ironbridge; and no. 55_3, Woolhope.

2. *Strepula irregularis*, sp. nov.
(Pl. XIII. figs. 5, 7, 8 *a*, 8 *b*, 9 *a*, 9 *b*, 9 *c*, and 15.)

Proportions : { Fig. 8 : L. 20. H. 12. Th. 10.
Fig. 9 : L. 24. H. 12. Th. 10. }

* Diminutive of *Strepa* (Lat.), a stirrup, from the loop-like pattern of the ridges.

† If these proportional numbers be divided by 15, the results will be measurements in a millimetre and parts of a millimetre.

The typical ridging here seems to be (within the supramarginal outstanding ridge) an inner, irregularly concentric, and an innermost, variable, three-limbed ridge, like a curved trident or a distorted ꙍ, all thin and some trenchant. A lobular swelling rises within the arms of the tripartite ridge in fig. 7. In all cases the surface is coarsely reticulate. In fig. 8 the supramarginal ridge is so prominent as to be very evident at the sides in the dorsal view (fig. 8 *b*); in fig. 9 it stands out in the ventral view (9 *c*), but not in the dorsal aspect (9 *b*).

Figs. 5 and 15 are interiors of such valves as fig. 7. The reticulate ornament is partly visible through the test in these specimens.

This species occurs in Mr. Smith's collection—no. $11_{1,2,5}$, and no. 70, Lincoln Hill, Ironbridge; and in Mr. Vine's collection, XLIX, bed no. 25.

The late J. G. O. Linnarsson described and figured an analogous form as *Beyrichia costata* from the *Beyrichia*-limestone of Angelin's stage "Regio Trinucleorum D *a* (?)" of the Lower Silurian (or Cambrian) of West Gothland. See Kongl. Svenska Vetenskaps-Akad. Handlingar, vol. viii. 1869, p. 85, pl. ii. fig. 67.

3. *Strepula beyrichioides*, sp. nov.
(Pl. XIII. figs. 2 and 3.)

Proportions : { Fig. 2 : L. 9. H. 5.
Fig. 3 : L. 16. H. 10.

In fig. 2 we have a small, neat, almost semicircular valve, bearing two concentric ridges—one outstanding, sharp, and above and parallel with the ventral margin, which it hides; the other less regular and not quite entire, within the former. An oval isolated lobe occupies the centre of the valve.

This form comes near to *Strepula concentrica* on one hand, and on the other to some of the varieties of *Beyrichia Klœdeni*, especially as one end of the inner ridge is sublobular, faintly imitating the *gigot*-lobe. The outstanding supramarginal ridge, the almost continuous inner ridge formed by the two end lobes, and the isolation of the central lobe, taken altogether, give it a peculiar character.

Fig. 3 shows a larger form, somewhat similar in outline and general aspect to fig. 2. Here the outer or supramarginal ridge is strongly prominent, and two asymmetrical, obliquely transverse, narrow, rough lobes almost meet below an isolated, guttiform, subcentral lobe.

As it is possible that by development in age the small form (fig. 2) might have approximated to the larger form (fig. 3), we associate them together under the name of *Strepula beyrichioides*—in the first place as having reference to their exhibiting the concentric ridging of the new genus *Strepula*, and, secondly, a somewhat trilobate form like some *Beyrichiæ*.

In both cases (figs. 2 and 3) the dorsal edge view is like that of a three-lobed *Beyrichia*.

Str. beyrichioides is rare in the Smith Coll., no. $11_{3,4}$, Lincoln Hill, Ironbridge; and Vine Coll. LXVI_{11}, Tickwood Beds; LXVII_{11}, Tickwood Beds.

4. *Bollia* † *Vinei*, sp. nov. (Pl. XIII. fig. 14.)

Proportions :—L. 10. H. 6.

Carapace-valve small, suboblong, with well-curved ventral border; flattish and thick; surface reticulated. The bilobular, semicircular, central ridge is proportionally small, but very distinct. The supramarginal ridge is thick, and the meshes of the reticulate sculpture enlarge along a line just within it, forming there a series of pits. There is a specimen fixed on a piece of shell in the Vine Coll. XXXIV_3, bed no. 37; also one specimen in the Smith Coll. no. 55_8, Woolhope.

4*. *Bollia Vinei*, var. *mitis*, nov. (Pl. XIII. fig. 13.)

Proportions :—L. 11. H. 6.

This little oblong valve is slightly longer in proportion than *B. Vinei*, and the outer of the two curved ridges is within the margin and less pronounced; the sculpture also is weaker and more uniform. There is another specimen in which these features are still less pronounced, but they are essentially the same as in the foregoing *B. Vinei*. Vine Coll. XXXIV_1, bed no. 37.

Among the small figures of Silurian Entomostraca from Scandinavia in pl. v. illustrating K. Haupt's "Die Fauna des Graptolithen-Gesteines," &c., in vol. liv. of the 'Neues Lausitzisches Magazin' (8vo, Gorlitz, 1878), there are two that look like *Bollia* at first sight, namely figs. 9 *a*, *b*; but they appear to have a small subcentral lobe low down within the curved ridge. The specimens seem to have been about 2 millim. long. Fig. 11 also in the same plate may possibly illustrate an allied form, but no curved ridge is visible. This

† For *Bollia* see Ann. & Mag. Nat. Hist. for April 1886, p. 360.

specimen may have been about 1·5 millim. long. No descriptions are given, but figs. 9 *a*, *b*, were supposed to be *Beyrichia Klœdeni*, and fig. 11 was referred to as a *Beyrichia*, with the two little knobs more to one side than shown by the draughtsman.

PLACENTULA, gen. nov.

Primitia, pars, Jones & Holl, Ann. & Mag. Nat. Hist., March 1869, p. 222.

Valves suborbicular, nearly semicircular on the ventral border, straight on the dorsal margin inside, but projecting with unequal and variable angles at the outer dorsal region. Surface flat or slightly convex, surrounded by a raised rim, which slopes down suddenly outside to the edge of the valve. This rim encloses a depressed and reticulated area, and in or near the antero-dorsal region there is a small depression defined by a raised loop-like border. Within certain bounds all these features are variable in different individuals.

The little loop looks like the curved ridge of *Bollia* pushed away out of place, and in some cases is almost obsolete. Though apparently near to the little *Bolliæ* of figs. 13 and 14, yet this form can scarcely belong to that genus, as the loop touches and runs into the dorsal border; and the general shape is different. We do not now think that it finds its right place in *Primitia*, and prefer to regard it as distinct under the new generic name of PLACENTULA (Lat., a little cake).

5. *Placentula excavata*, Jones and Holl. (Pl. XIII. figs. 10 *a*, 10 *b*, 11, 12, and 16.)

Primitia excavata, J. & H., Ann. & Mag. Nat. Hist. ser. 4, vol. iii. 1869, p. 222, pl. xv. figs. 10 *a*, *b*, *c*.

Proportions:	Figs. 10, 11, 12:	L. 11.	H. 7.	Th. 5.
	Fig. 16: . . .	L. 15.	H. 10.	
	Original specimen:	L. 14.	H. 9.	Th. 6.

These little bun-shaped carapaces often differ slightly from the specimen first described and figured, the dorsal sulcus being clearly defined by a narrow, raised, slightly oblique loop; and the raised marginal rim is more distinctly marked in several individuals, but not more so in others.

This is a variable species, individuals differing in size, outline, relative convexity, the strength of the loop and of the supramarginal border, and in the intensity of sculpture.

The larger specimen (fig. 16) of an interior has the straight dorsal edge, and shows a swollen dorsal region, as in fig. 11.

This species is not uncommon in bed 25*, Vine Coll., XXIX; and at Woolhope, Smith Coll. no. 66 and no. 72; also at Lincoln Hill, Ironbridge, no. 70.

6. *Primitia* † *lenticularis*, Jones and Holl.
(Pl. XIV. figs. 1 *a*, 1 *b*.)

Primitia lenticularis, J. & H., Ann. & Mag. Nat. Hist. ser. 4, vol. iii. 1869, p. 219, woodcuts, figs. 4 *a*, *b*, *c*.

Proportions: { Fig. 1: L. 17. H. 15. Th. 9.
Spec. fig. in 1869: L. 19. H. 14. Th. 10.

Some specimens closely corresponding in side view and profiles with those described and figured in 1869 occur in the Smith Coll. no. 39, Dudley Castle; no. 58, railway-cutting, side of Severn, Ironbridge; no. 59, Red Shale, Malvern Tunnel; no. 71, Sedgeley (Wenlock Shale): in the Vine Coll. $\text{XXXI}_{1,2}$, bed no. 25; XXXIII, bed no. 25*; and LXVI_{6}, Tickwood Beds. Most abundantly in nos. 58 and 59.

7. *Primitia Rœmeriana*, Jones and Holl.

Primitia Rœmeriana, J. & H., Ann. & Mag. Nat. Hist. ser. 3, vol. xvi. 1865, p. 422, pl. xiii. figs. 8 *a*, *b*.

Proportions:—L. 17. H. 13. Th. 5.

This occurs in the Vine Coll. XXXII, bed no. 46; $\text{LXV}_{5,6}$, Shale over the Wenlock Limestone; and LVI, bed no. 46.

8. *Primitia fabulina*, sp. nov.
(Pl. XIV. figs. 2 *a*, 2 *b*.)

Proportions:—L. 15. H. 10. Th. 6.

This is a rather small, bean-shaped, compressed, ovate-oblong *Primitia*, near *P. variolata*, J. & H., in general aspect, but it is much more compressed at the ends, especially anteriorly, and has a smooth surface. The edge view is narrow-ovate, acute at each end.

This is found in some numbers in Smith's Coll. no. 48, Dudley Tunnel; and in Vine Coll., $\text{LIV}_{1\,\&\,4}$, bed no. 37.

9. *Primitia variolata*, Jones and Holl.

Primitia variolata, J. & H. Ann. & Mag. Nat. Hist. ser. 3, vol. xvi. 1865, p. 418, pl. xiii. figs. 6 *a*, *b*.

Proportions:—L. 11. H. 7·5. Th. 4·5.

† For *Primitia* see Ann. & Mag. Nat. Hist. ser. 3, vol. xvi. 1865, p. 415.

Present in the Smith Coll. no. 36, railway-cutting, side of Severn, Ironbridge; and in Vine Coll. LXV$_{4\,\&\,11}$, Shales over the Wenlock Limestone.

10. *Primitia paucipunctata*, Jones and Holl.
(Pl. XIV. figs. 3 *a*, 3 *b*.)

Primitia variolata, var. *paucipunctata*, J. & H. *op. cit.* p. 419, pl. xiii. figs. 6 *c*, 6 *d*.

Proportions: { Fig. 3: L. 14. H. 8. Th. 7.
Figured in 1865: L. 13. H. 8. Th. 5.

We find that perfect specimens do not possess the supposed antero-dorsal rim or marginal extension indicated in fig. 6 *c*, above quoted. The absence of a rim and its more ovate outline, besides its ornament, distinguish it from *P. variolata*, and being constant in occurrence it may fairly claim a specific standing.

It occurs in the Vine Coll. XXII$_{1,2}$, bed 25 (common); XXIII, bed 25* (not rare); and LXVI$_{11\,\&\,14}$, Tickwood Beds.

* 11. *Primitia humilis*, sp. nov.
(Pl. XIV. figs. 6 *a*, 6 *b*, 9 *a*, 9 *b*, 9 *c*.)

Proportions: { Fig. 6: L. 10. H. 6. Th. 4.
Fig. 9: L. 14. H. 8. Th. 6.

Valves nearly oblong, but rounded at the ends; not very convex, compressed forward, steep at the edges, but less so anteriorly. Sulcus constricted dorsally, so as to form a rather deep subcentral pit. Dorsal view cuneiform, rounded at the thin end (anterior), and truncate behind. This is not a rare form. Some few specimens show a very faint punctation. Fig. 9 *c* shows an interior, with the dorsal edge and its hinge-line. Figs. 6 *a*, *b*, evidently represent a young form of the same lowly but characteristic species. In the Smith Coll. no. 51, there are two very small individuals from Woolhope. In the Vine Coll. XXV, bed no. 25; XXXVI$_4$, bed no. 37; LXIII, bed no. 25; LXIV$_{4,8,9}$, bed no. 37.

12. *Primitia valida*, sp. nov.
(Pl. XIV. figs. 7 *a*, 7 *b*, 7 *c*.)

Proportions:—L. 18. H. 12. Th. 10.

A large, thick, Leperditioid *Primitia*, very convex along the ventral region and at the posterior third; compressed dorsally. Surface finely reticulated, often obscured by weathering. Valves marked with a shallow, broad, subcentral pit. Carapace half as long again as high, and almost as thick as high. Edge view subovate, sharp in front; end view sharp

above, tumid below. Slight marginal rim traceable in some specimens. This is near *P. umbilicata*, but is squarer, thicker ventrally, and always more or less reticulated.

In Smith Coll. no. 69, Woolhope (poor variety); no. 76 (part), Lincoln Hill, Ironbridge. Vine Coll. XXVII, bed no. 46 (a variety); XXVIII1, 2, 3, bed no. 46; LXV12, Shales over the Wenlock Limestone; and LXVII, bed no. 46 (including a variety).

12*. *Primitia valida*, var. *breviata*, nov. (Pl. XIV. figs. 8 *a*, 8 *b*.)

Proportions:—L. 13. H. 9. Th. 8.

This agrees with *P. valida* in all respects, except in being smaller and relatively shorter, and not showing the central depression.

Vine Coll. XXVI1, 2, 3, bed no. 46; LXV12 (part), Shales over the Wenlock Limestone.

12**. *Primitia valida*, var. *angustata*, nov. (Pl. XIV. figs. 4 *a*, 4 *b*.)

Proportions:—L. 14. H. 8. Th. 6.

In this the relative height and thickness of the valves are much less than in the two foregoing forms; otherwise the features are closely similar. The usual depression on the valves is here subcentral, towards the antero-dorsal region, and is more open and undefined.

Vine Coll. XXVIII4, bed no. 46; LXV13 (part), Shales over the Wenlock Limestone.

13. *Primitia tersa*, Jones and Holl.

Primitia tersa, J. & H., Ann. & Mag. Nat. Hist. ser. 3, vol. xvi. 1865, p. 421, pl. xiii. figs 3 *a*, *b*, *c*.

Proportions:—L. 14. H. 9. Th. 9.

This occurs at the railway-cutting, side of Severn, Ironbridge, no. 78, Smith Coll., with a quite or nearly smooth surface; but a reticulate variety occurs in no. 78, Dudley Tunnel.

14. *Primitia umbilicata*, Jones and Holl.

Primitia umbilicata, J. & H. *op. cit.* p. 420, pl. xiii. figs. 2 *a*–*d*.

Proportions:—L. 15. H. 11. Th. 9.

This occurs as a reticulated variety in the Smith Collection, no. 73, railway-cutting, side of Severn, Ironbridge, and no. 77,

Dudley Tunnel. In nos. 26 and 78, railway-cutting, side of Severn, Ironbridge, it is smooth. In the Vine Collection LXVI$_7$ (part)), Tickwood Beds, it is also present.

15. *Primitia cristata*, Jones and Holl.

Primitia cristata, J. & H *op cit.* figs 1 *a*, *b*, *c*.

Proportions:—L 15. H. 11·25. Th. 11·5.

This well-marked species is rather abundant in some of the Shales (Tickwood Beds) in Vine Coll. XXX and LXVI$_7$, in both cases showing delicate toothing on the front margin of each valve.

16. *Primitia ornata*, sp. nov. (Pl. XIV. fig. 5)

Proportions:—L. 10. H. 6.

A small, moderately and equally convex, suboblong, Leperditioid form, straight at the back, with a long hinge-line; curved on the free edges; the ventral longest and gently curved; ends nearly semicircular, but the posterior boldest. Surface coarsely reticulated with neat meshes and bordered with a slight rim. Dorsal sulcus median and variable, sometimes ending in a definite central pit, sometimes represented only by a subumbilical hollow.

Though near to *P. variolata*, this is distinguished by its shape, ornament, and small size. The dorsal profile of the carapace is a narrow oblong with rounded ends.

In the Vine Coll. XXIV, bed 25; Smith Coll. nos 55 and 72, Woolhope, and no. 76 (part)), Lincoln Hill, Ironbridge. It is not common.

17. *Primitia cornuta*, sp. nov.
(Pl. XIV. figs. 12 *a*, 12 *b*, and fig. 13 (young).)

Proportions: { Fig. 12: L. 18. H. 10. Th. 7, and between the tips 11.
Fig. 13: L. 9. H. 6. }

Carapace semiovate, straight on the back, elliptically curved on the free edges, being semicircular behind, and broadly and obliquely curved on the ventral and anterior margins up to the antero-dorsal angle. Surface finely reticulate, with some meshes larger here and there, forming small pits; convex behind, compressed in front, excepting that the antero-ventral region of each valve bears an outstanding sharp tubercle. Another, but shorter, tubercle projects from each postero-dorsal region. Hence the dorsal view (fig. 12 *b*) gives a bluntly rounded end behind, and a sharp front end, with the lateral

horn-like projections at the anterior third reaching further out than those behind.

The small specimen (fig. 13), though smooth and having the antero-ventral tubercle undeveloped, is sufficiently like the foregoing to be regarded as a young form or an arrested dwarf. This specimen (from bed no. 37?) has been lost.

P. cornuta is represented by a unique carapace in the Vine Collection, XXXV, bed no. 40.

We connect this and the two following species with *Primitia*, regarding the tubercles as representing essentially the elevated sides of the modified dorsal furrow.

18. *Primitia æqualis*, sp. nov.
(Pl. XIV. figs. 11 *a*, 11 *b*.)

Proportions:—L. 16. H. 9. Th. 5, and between the tips 6.

This is Leperditioid in shape, and like *P. valida*, var. *angustata*, in lateral aspect, but differing in dorsal outline. It has two equal, prominent, rounded tubercles in the middle-dorsal region, almost in a line, marking off thirds of the length, and connected below by a feebly-raised loop-like ridge, curving over the centre of the valve. The dorsal aspect is narrow-ovate, with the four outstanding tubercles symmetrically disposed in fore and aft pairs. The surface is finely reticulated, and the hinge-line delicately denticulate.

Smith Coll., no. 37, railway-cutting, Coalbrook Dale; and no. 38, railway-cutting, side of Severn, Ironbridge. Rare.

This species reminds us of *P. bicornis*, Jones (Ann. & Mag. Nat. Hist. ser. 2, vol. xvi. p. 173, 1855, pl. vi. fig. 23), from the Lower Silurian; but, besides other differences, the proportions of the latter are: L. 18·75. H. 9·25. Th. 9·25. The faint loop, evidently a family link with *Bollia*, *Placentula*, and *Strepula*, serves to show that the centro-dorsal sulcus is not quite obsolete in these cornute *Primitiæ*. It is more definitely marked in the allied *P. bicornis* and *P. mundula*, Jones (*op. cit.* figs. 23, 28–31).

19. *Primitia diversa*, sp. nov.
(Pl. XIV. figs. 10 *a*, 10 *b*, 10 *c*.)

Proportions:—L. 14. H. 7. Th. 6, and between the tips 8.

Valves straight-backed, Leperditioid, and subconvex. Surface finely reticulated or marked with small scattered pits; irregularly undulate, and rising into two unequal tubercles, one near the middle of the front third, the other low down on the hinder third. Dorsal view of the closed carapace narrow-ovate, with lateral, projecting, unequal tubercles.

In the Vine Collection XXXVI$_{1,2,3}$, and XXXVII, bed no. 37; also LXIV, Buildwas Beds. Rather common.

20. *Primitia seminulum*, Jones.
(Pl. XIV. figs. 14 *a*, 14 *b*, 14 *c*.)

* *Beyrichia seminulum*, Jones, Ann. & Mag. Nat. Hist. ser. 2, vol. xvi. 1855, p. 173, pl. vi. fig. 24.
Primitia seminulum, J. & H., *op. cit.* ser. 3, vol. xvi. 1865, p. 418.

Proportions: { Fig. 14 *a*, *b*: . . L. 17. H. 10. Th. 8.
Fig. 14 *c*: . . . . L. 14. H. 9.
Figured in 1855: L. 18·75. H. 11·25.

The original description of this pretty little semicircular *Primitia* needs to be supplemented only by the remarks, that the present specimens are clearly and elegantly reticulated; that the dorsal sulcus traverses rather more than a third of the height of the valve and is not always quite straight; and, lastly, that the individuals vary in relative length. Fig. 14 *c* is the outline of a short valve.

Smith Coll. no. 26, railway-cutting, side of Severn, Ironbridge (worn); no. 35, Lincoln Hill, Ironbridge; no. 54, Woolhope; no. 74, Wren's Nest, Dudley; no. 75, Benthall Edge. An abundant species.

21. *Primitia furcata*, sp. nov.
(Pl. XIV. figs. 15 *a*, 15 *b*.)

Proportions:—L. 19. H. 9. Th. 8.

This unique carapace is skiff-shaped, with a straight back and elliptical lower margin, which curves up sharply behind, and much more gently and slopingly to the projecting antero-dorsal angle. The valves are fully convex in the hinder two thirds, but are compressed in front. The surface is smooth, and impressed at the middle of the back with a well-marked sulcus, which widens out into a shallow fork at about the middle of the valve. A neat rim borders the free edge. Dorsal view subovate, acute in front, straight at the sides, and roundly truncate behind. The valves remaining slightly apart in the figured specimen give a slightly deeper outline in fig. 15 *a* at first sight than is real.

Smith Coll. no. 43, Dudley Tunnel.

EXPLANATION OF THE PLATES.

[The figures are magnified about 15 diameters.]

Plate XIII.

Fig. 1. *Strepula concentrica*, gen. et sp. nov. Carapace: *a*, lateral view, left valve outwards; *b*, dorsal view. Smith Coll. no. 42, railway-cutting, side of Severn, Ironbridge.

Fig. 2. *Strepula beyrichioides*, sp. nov. Right valve. Smith Coll. no. 11_4, Lincoln Hill, Ironbridge.

Fig. 3. The same. Right valve. Smith Coll. no. 11_3, Lincoln Hill, Ironbridge.

Fig. 4. *Strepula concentrica*, sp. nov. Right valve. Smith Coll. no. 11_4, Lincoln Hill, Ironbridge.

Fig. 5. *Strepula irregularis*, sp. nov. Interior of right valve. Smith Coll. no. 11_2, Lincoln Hill, Ironbridge.

Fig. 6. *Strepula concentrica*, sp. nov. Right valve. Smith Coll. no. 55_3, Woolhope.

Fig. 7. *Strepula irregularis*, sp nov. Left valve. Smith Coll. no. 11_3, Lincoln Hill, Ironbridge.

Fig. 8. The same. Carapace: *a*, right valve; *b*, dorsal view. Smith Coll. no. 11_1, Lincoln Hill, Ironbridge.

Fig. 9. The same. Carapace: *a*, right valve; *b*, dorsal view; *c*, ventral view. Vine Coll. XLIX, bed 25.

Fig. 10. *Placentula excavata*, J. & H. Carapace: *a*, left valve; *b*, dorsal view. Vine Coll. XXIX_1, bed 25*.

Fig. 11. The same. Right valve. Vine Coll. XXIX_2, bed 25*.

Fig. 12. The same. Right valve. Vine Coll. XXIX_5, bed 25*.

Fig. 13. *Bollia Vinei*, var. *mitis*, sp. et var. nov. Right valve. Vine Coll. XXXIV_1, bed 37.

Fig. 14. *Bollia Vinei*, sp. nov. Left valve. Vine Coll. XXXIV_3, bed 37.

Fig. 15. *Strepula irregularis*, sp. nov. Interior of right valve. Smith Coll. no. 70, Lincoln Hill, Ironbridge.

Fig. 16. *Placentula excavata*, J. & H. Interior of right valve. Smith Coll. no. 66, Woolhope.

PLATE XIV.

Fig. 1. *Primitia lenticularis*, J. & H. Carapace (not reticulate): *a*, left valve; *b*, dorsal view. Vine Coll. XXXI_1, bed 25.

Fig. 2. *Primitia fabulina*, sp. nov. Carapace: *a*, right valve; *b*, ventral view. Smith Coll. no. $48_{1,2}$, Dudley Tunnel.

Fig. 3. *Primitia paucipunctata*, J. & H. Carapace: *a*, right valve; *b*, ventral view. Vine Coll. $\text{XXIII}_{1,2}$, bed 25.

Fig. 4. *Primitia valida*, var. *angustata*, nov. Carapace: *a*, left valve; *b*, end view. Vine Coll. XXVIII_4, bed 46.

Fig. 5. *Primitia ornata*, sp. nov. Right valve. Vine Coll. XXIV, bed 25.

Fig. 6. *Primitia humilis*, sp. nov. *a*, right valve; *b*, edge view. Vine Coll. XXV, bed 25.

Fig. 7. *Primitia valida*, sp. nov. Carapace: *a*, left valve; *b*, edge view; *c*, end view. Vine Coll. XXVIII_2, bed 46.

Fig. 8. *Primitia valida*, var. *breviata*. Carapace: *a*, right valve; *b*, edge view. Vine Coll. XXVI_3, bed 46.

Fig. 9. *Primitia humilis*, sp. nov. *a*, right valve; *b*, edge view of carapace; *c*, interior of left valve, filled with matrix [too convex above]. Vine Coll. LXIII, bed 25.

Fig. 10. *Primitia diversa*, sp. nov. *a*, right valve; *b*, dorsal view; *c*, ventral view. Different individuals. Vine Coll. $\text{XXXVII}_{1,2,3}$, bed 37.

Fig. 11. *Primitia æqualis*, sp. nov. Carapace: *a*, right valve; *b*, dorsal view. Smith Coll. no. 38, railway-cutting, Ironbridge.

Fig. 12. *Primitia cornuta*, sp. nov. Carapace: *a*, right valve; *b*, dorsal view. Vine Coll. XXXV, bed 40.

Fig. 13. The same, young. Right valve. Bed 37? (Specimen lost.)

Fig. 14. *Primitia seminulum*, Jones. Carapace: *a*, left valve; *b*, dorsal view; *c*, outline of a short right valve. Smith Coll. no. 64, Woolhope.

Fig. 15. *Primitia furcata*, sp. nov. Carapace: *a*, right valve outwards, and edge of left valve partly seen; *b*, dorsal view. Smith Coll. no. 43, Dudley Tunnel.

XXXVII.—*New Neotropical Curculionidæ.*—Part VI. By Francis P. Pascoe.

BRACHYDERINÆ.

Athetetes, n. g.
—— globicollis
Melactus, n. g., for Cyphus bispinus &c.
Dysphiles, n. g.
—— ferrugatus

ERIRHININÆ.

Ætiomerus, n. g.
—— nodosus.

BELINÆ.

Homalocerus punctum.

MAGDALINÆ.

Læmosaccus blandus.
—— rufescens.
—— ebenus

CHOLINÆ.

Cholus Oberthuri.
—— megaspilus.
—— canescens.
Erethistes amplicollis.

CRYPTORHYNCHINÆ.

Elytrocoptus prolifer.
Cyphorhynchus diurus.
—— crassus.
Cryptacrus scops.
Diaporesis, n. g.
—— distincta.

ZYGOPINÆ.

Piazurus stellaris
—— lætus.
—— sacer.
—— diversus.

BARIDINÆ.

Baris magister.
—— fervida
Eurhinus cupripes.
—— eximius.
Ganymela, n. g.
—— nitida.

MADARIDÆ.

Eutoxus corax.

ATHETETES.

Naupacto similis sed differt. *Tibiæ posticæ* corbellis cavernosis, et *elytra* quam *prothorax* haud latiora.

This genus agrees with the typical species of *Naupactus* in its long and slender antennæ and the great length of the second joint of the funicle compared to the first. All others not possessing these characters should be excluded from that genus, as well as those whose elytra are not broader at the base than the prothorax. Some of the latter, like *N. durius*, have been referred to *Eurymetopus* *, and others, like *N. lacertosus*, to *Pantoplanes*. In these genera the corbels are open,

* This genus of Schonherr's has been changed in the 'Munich Catalogue' into *Metoponeurys* as being too near *Eurymetopon*. If every name among the 80,000 genera of animals is, from a mere similarity of sound, to be changed, except the original, there can be no certainty for many now familiar names; what will be sufficiently clear for some will not for others, for whom such changes are a delight

as in *Naupactus*. I am not quite sure that what appears to be a minute transverse scutellum is really one.

Athetetes globicollis.

A. oblongus, piceus, squamis griseis haud dense vestitus; antennæ funiculo articulo secundo quam primo triplo longiore. Long. 4 lin.

Hab. Mexico.

Oblong, pitchy, clothed with greyish approximate scales; rostrum flat in front, bounded on each side by two sharply defined lines; antennæ very slender, the scape extending to the prothorax, the second joint of the funicle three times as long as the first, the three next equal in length, but together not longer than the second, the last two shorter, especially the sixth, club oblong-ovate; prothorax globose, the apex and base truncate; scutellum inconspicuous; elytra narrower than the prothorax, gradually rounded from the middle, convex, seriate-punctate, punctures small; legs with sparse scales, the anterior much longer, with glaucous green scales, and their femora thicker than the others.

Melactus.

This generic name is proposed for *Cyphus bispinus* and *Cyphus lugubris*, but the corbels of the posterior tibiæ being open, as in *Naupactus*, it is to the neighbourhood of that genus that, as Lacordaire has pointed out, it must be referred (see Gen. vi. p. 115).

Dysphiles.

Oculi depressi. *Rostrum* crassiusculum, scrobes arcuatæ, infra oculos attingentes. *Antennæ* mediocres, funiculo articulis duobus ultimis transversis. *Prothorax* rotundatus, apice basique truncatus. *Scutellum* invisum. *Elytra* breviter ovata, basi quam prothorax haud latiora. *Abdomen* segmento secundo quam tertio quartoque conjunctis æquali. *Pedes* breves; *femora* crassa; *tibiæ* flexuosæ; *tarsi* lati; *unguiculi* liberi.

Bastactes is probably the nearest ally of this genus; but in that genus the scrobe does not reach the eye, and the three intermediate segments of the abdomen are equal in length; the form of the prothorax and elytra are also very different, and, which is of less consequence, the last joint of the funicle is elongate. Lacordaire is in error in saying there is no scutellum; it is distinct enough in a fresh specimen, and covered

with silaceous scales. In *Dysphiles* the elytra form a deep cavity which should be occupied by the scutellum.

Dysphiles ferrugatus.

D. breviusculus, tomento rufo-brunneo dense tectus, supra tuberculis plurimis instructus; capite supra oculos producto. Long. 2 lin.

Hab. Brazil.

Rather short, closely covered with a reddish-brown tomentum; head slightly produced over the eye; rostrum broadly excavated at the side (sometimes filled in by an excess of tomentum); antennæ ferruginous; prothorax roughly tuberculate, rounded at the sides; elytra very short, ovate, moderately convex, suddenly declivous behind, studded with unequal tubercles, each bearing a stiff curved seta, the intervals concave and irregularly punctured; body beneath and legs tomentose, with scattered setæ; the claw-joint also setose.

ÆTIOMERUS.

Caput haud exsertum; *oculi* prominuli, grosse granulati; *rostrum* prothorace longius, a basi gradatim latius; *scrobes* subapicales, infra rostrum currentes. *Antennæ* graciles, scapo oculum attingente. *Prothorax* parvus. *Elytra* ampliata, convexa. *Propectus* breve. *Abdomen* segmentis duobus basalibus majusculis, sutura prima arcuata. *Femora* pedunculata, in medio crassa, subtus dentata, sed posteriora dente magno triangulari instructa; *tibiæ* arcuatæ; *tarsi* articulo penultimo profunde bilobo; *unguiculi* liberi.

A remarkable genus, unlike any other of the group—principally from New Zealand—to which Mr. C. Waterhouse would refer it. I am half inclined to regard it as an aberrant form allied to *Piazurus*.

Ætiomerus nodosus.

Æ. obscure fuscus, supra tuberculis plurimis instructus, prothorace utrinque parallelo apicem versus abrupte constricto. Long. $3\frac{1}{4}$ lin.

Hab. Huallaga (Peru).

Dull brown, opaque, with numerous unequal tubercles above; rostrum moderately curved, much broader beyond the insertion of the antennæ, coarsely punctured, a well-marked ridge in the middle; antennæ ferruginous, the two basal joints of the funicle of equal length, club ovate, pointed; prothorax slightly transverse, parallel at the sides and suddenly con-

tracted at the apex, the disk with about eight tubercles; scutellum oblong, scaly; elytra as broad again as the prothorax, slightly narrowing towards the broadly rounded apex, tubercles numerous, the four principal ones nearly central; abdomen and metasternum glossy black; legs with much scattered elongate scales.

Homalocerus punctum.

H. elongatus, parallelus, niger, pilis griseis minutis adspersus; prothorace in medio et ad latera macula rubro-aurantiaca ornato; elytris apice ad suturam mucronatis. Long. 4 lin.

Hab. Parana.

Elongate, parallel at the sides, black, with scattered minute greyish hairs, condensed and forming a stripe on the outer margin of the elytra; eyes very prominent; rostrum remotely punctured; prothorax nearly as long as broad, studded with small black granules, a dense patch of clear reddish-orange scales in the centre and a similar patch at the side in front, and behind the latter a larger white one; scutellum inconspicuous; elytra seriate-punctate, the interstices closely granulate, the apex of each prolonged at the suture into a short conical point; legs ferruginous.

Allied to *H. lateralis* (an unpublished name, I believe, common in collections), but with a longer and narrower prothorax, apiculate elytra, and without the central prothoracic spot.

Læmosaccus blandus.

L. oblongus, subcylindricus, fusco-castaneus, pilis albis inæqualiter vestitus; elytris postice abrupte declivibus, apice singulatim tuberculato-fasciculatis. Long. 2¼ lin.

Hab. Parana.

Oblong, subcylindric, dark brown or chestnut, unequally clothed with fine white hairs, those on the basal half of the elytra more densely set, and, in my specimen, assuming the form of the letter X; rostrum stoutish, finely punctured; antennæ ferruginous; prothorax finely punctured, the sides, except at the apex, nearly parallel, the anterior portion with two well-marked callosities; scutellum round; elytra very slightly broader behind, somewhat interruptedly striate, the interstices finely punctured, the alternate ones raised, the fifth at the declivity with a small black fasciculate tubercle; legs ferruginous; all the femora with a triangular tooth; anterior tibiæ strongly curved.

This species may be placed near *L. variegatus*; but it

differs in having no tubercles on the elytra, except the two at the declivity.

Læmosaccus rufescens.

L. oblongus, postice gradatim latior, rufo-ferrugineus; elytris postice abrupte declivibus, apice singulatim quadrituberculatis. Long. $2\frac{1}{3}$-3 lin.

Hab. Parana.

Oblong, gradually narrowing behind, reddish ferruginous; rostrum finely punctured; prothorax nearly as broad as long, irregularly rounded at the sides, and closely covered (in fresh specimens) with a fulvous tomentum, the apex with two callosities, having a deep excavation between them; scutellum oval, raised; elytra seriate-punctate, punctures approximate, the alternate interstices raised, the third, fifth, and ninth ending in a tubercle at the declivity, and a larger conical tubercle at the apex; femora obsoletely toothed; anterior tibiæ nearly straight.

In this and the preceding species the two basal joints of the funicle are equal in length, but the first is conspicuously stouter.

Læmosaccus ebenus.

L. perbrevis, parallelus, niger, nitidus; clava antennarum elongata, funiculo longiore; elytris apice singulatim rotundatis. Long. $1\frac{1}{4}$ lin.

Hab. St. Catharine's.

Very short, the sides parallel, glossy black; antennæ ferruginous, the club longer than the funicle; rostrum shorter than the head, closely punctured; prothorax abruptly contracted at the apex, reticulate-punctate, scutellar lobe produced; scutellum round; elytra about a third longer than broad, deeply sulcate and transversely punctate, the punctures closely approximate, interstices raised, especially the middle portion of the third, each elytron rounded at the apex; femora with a spiniform tooth; anterior tibiæ slightly curved, with oblong contiguous punctures.

The unusually short funicle seems to be the peculiar feature of this curious little species. *Læmosaccus* has strong affinities with *Magdalis*; but the latter is placed by Lacordaire in his "Symmerides" on account of their contiguous coxæ. But this character is common also to the Brazilian species, and, since their affinity to the Australian and Malayan is undoubted—although perhaps they should be placed in separate genera—the character in this case loses its usual importance,

and the genus should, I think, therefore be placed in the Magdalinæ.

Cholus Oberthürii.

C. oblongus, fuscus, nitidus, maculis niveis parvis adspersus; rostro ferrugineo, in medio carinato; prothorace transversim subtiliter granulato. Long. 7 lin.

Hab. Santo Paulo d'Olivença (Upper Amazon).

Oblong, glossy dark brown; rostrum smooth, ferruginous, with a well marked ridge in the middle; antennæ pitchy, scape moderately long; prothorax subtriangular, marked with delicate transverse linear granules, the intervals with a few punctures and scattered silaceous scales, some condensed on each side, forming three or four spots; scutellum oblong, rounded at the apex; elytra slightly depressed at the base, seriate-punctate, the interstices marked with narrow transverse interrupted raised lines, and numerous small distinct silaceous spots; legs ferruginous, nearly glabrous; body beneath closely covered with yellowish silaceous scales.

Allied to *C. Buckleyi*, a more convex species without a rostral carina, a minutely punctured prothorax, and otherwise sculptured. Named after M. René Oberthür, of Rennes, to whom I am indebted for this and other interesting forms.

Cholus megaspilus.

C. oblongus, niger, nitidus; elytris maculis niveis majusculis ornatis; antennis articulis duabus basalibus funiculi brevibus; scutello angusto. Long. 7 lin.

Hab. Sarayacu (Peru).

Oblong, black, glossy; rostrum smooth, with two diverging grooves at the base; antennæ moderately long, the two basal joints of the funicle short; prothorax minutely punctured; scutellum narrowly oblong; elytra convex, seriate-punctate, punctures minute, on each four or five round depressions filled with snow-white scales; body beneath and legs smooth.

Closely allied to *C. nitidicollis*, but with shorter antennæ, oblong scutellum, the elytra more convex and with fewer and larger spots.

Cholus canescens.

C. anguste subellipticus, paulo convexus, castaneus, squamulis pallide silaceis sejunctim vestitus; elytris seriatim punctatis, interstitiis conformibus; mesosterno depresso. Long. 4 lin.

Hab. Panama.

Narrowly subelliptic, slightly convex, chestnut-brown, with small, pale, silaceous, non-contiguous scales; rostrum chestnut, smooth, except at the base; antennæ ferruginous, basal joint of the funicle nearly as long as the two next together; prothorax with rounded, more or less remote glossy granules; scutellum subscutiform; elytra seriate-punctate, punctures scarcely approximate, interstices not raised; legs and body beneath with scattered pale yellowish scales, but the last three segments of abdomen smooth except at the sides; mesosternum depressed.

A narrower species than *C. uniformis*, more convex, with comparatively longer elytra, and differently sculptured.

Erethistes amplicollis.

E. angustus, niger, nitidus; elytris prothorace angustioribus, albo-sexmaculatis, seriatim grosse punctatis; pedibus tenuatis elongatis. Long. 3½ lin.

Hab. Santo Paulo d'Olivença.

Narrow, black, shining; elytra with two basal and two subapical spots and the apex white; rostrum pitchy, longer than the prothorax, minutely punctured; antennæ ferruginous, first joint of the funicle twice as long as the second, club elongate elliptic; prothorax sensibly longer than broad, regularly rounded at the sides, slightly convex, obsoletely punctured, and with a few short, scarcely elevated, transverse lines posteriorly; scutellum punctiform; elytra narrower than the prothorax and not much longer, gradually narrowing towards the apex, seriate-punctate, the punctures subtransverse, a short white oblique spot at the base of each, another behind the middle and the apex white; sides of the sterna closely covered with buff-coloured scales.

The nearest ally to this species is *E. leucospilus*, which is much stouter in all its parts and with a normal relation of the prothorax to the elytra; the white spots are also more numerous.

Elytrocoptus prolifer.

E. fuscus, opacus; elytris amplis, humeris calloso-productis apiceque late truncatis, linea arcuata determinata silacea ad latera alteraque submarginali ornatis. Long. 6 lin.

Hab. Nauta (Ecuador).

Opaque dark brown, sides of the elytra with curved silaceous lines; rostrum rather stout; antennæ pitchy; prothorax transverse, rounded at the sides, scutellar lobe slightly pointed, the disk roughly punctured, the punctures largest in

the middle towards the base; scutellum small, deeply sunk between the elytra and prothorax; elytra convex, much broader than the prothorax at the base, the apex broadly truncate, a row of coarse punctures by the suture gradually diminishing posteriorly, otherwise impunctate, a well-marked silaceous line beginning at the shoulder, curved inwards at the middle and again near the apex, and connected with a similar submarginal line—together forming a sort of figure of 8; body beneath and legs brown, with dispersed scales, anterior and intermediate femora slightly toothed; the two basal segments of the abdomen of equal length.

The coloration is somewhat similar to *Rhynchænus pusio* (what could have induced Linnæus to give so large a species such a specific name?), but the broadly truncate elytra gives it a place in Chevrolat's genus.

Cyphorhynchus diurus.

C. subovatus, fuscus, squamulis flavicantibus adspersus, supra tuberculatus; prothorace elytrisque lineis duabus obliquis niveis ad suturam in medio extensis ornatis, apice singulorum producto. Long. 2 lin.

Hab. Huallaga, Peru.

Subovate, brown, with scattered, minute, yellowish scales; a narrow, white, very distinct stripe from the side of the prothorax, continued obliquely to the elytra, and meeting its fellow at about the middle of the suture; rostrum shorter than the prothorax, gibbous at its junction with the head; antennæ ferruginous; prothorax very irregular, suddenly narrowed anteriorly, with two tubercles at the apex and two larger ones behind them; scutellum rounded; elytra broader than the prothorax, unequally tuberculate, the largest an oblong ridge near the middle and away from the suture, the intervals coarsely punctured, the apex of each diverging into a cylindrical horizontal tubercle; posterior femora strongly toothed; tibiæ compressed, curved; tarsi ferruginous.

Allied to *C. rugosus* (antè 'Annals,' Apr. 1881, p. 304), but smaller, narrower behind, and the elytra apiculate.

Cyphorhynchus crassus.

C. breviter ovatus, fuscus, supra tuberculatus et fasciculatus; prothorace apice bi- et in medio quadrifasciculato; elytris postice alte elevatis tunc abrupte declivibus. Long. 1¾ lin.

Hab. Brazil.

Much stouter than the preceding, the prothorax with six

fasciculi, the two apical the most prominent; elytra very broad at the base, gradually rising behind, then very abruptly declivous, the declivous part and a short oblique line behind the shoulder greyish white, the two largest tubercles above the declivity elongate and studded, as well as elsewhere, with short, thick, erect setæ; legs closely setulose.

Cryptacrus scops.

C. brevis, convexus, supra squamis griseis fusco-variis obsitus, setulisque erectis adspersus; elytris nodulosis, inæqualiter punctatis, pone medium griseis. Long. 2 lin.

Hab. Para.

Short, convex, covered with greyish, varied with brownish scales; rostrum rather short, the basal half scaly; antennæ ferruginous; prothorax transverse, subtriangular, longitudinally sulcate in the middle, and on each side with two tubercles, the anterior pair at the apex, the posterior larger and approximate to them, scutellar lobe produced; scutellum punctiform; elytra much broader than the prothorax, very convex, generally nodulose, the intervals punctured, from the shoulder curving to the suture a greyish raised line, towards the apex entirely pale grey; legs short; tibiæ compressed.

A short stout species with nodulose elytra.

DIAPORESIS.

Caput rotundatum; *oculi* laterales, grosse granulati; *rostrum* arcuatum, basi robustum, apice latius; *scrobes* breves. *Scapus* antennarum oculum vix attingens; *funiculus* elongatus, linearis; *clava* distincta. *Prothorax* basi bisinuatus, lobis ocularibus ciliatis. *Scutellum* inconspicuum. *Elytra* prothorace paulo latiora, humeris rotundatis. *Rima pectoralis* ante coxas intermedias terminata, apice aperta. *Pedes* modice elongati; *femora* vix clavata, infra dentata; *tibiæ* rectæ, apice uncinatæ; *tarsi* articulo basali subelongato; *unguiculi* liberi. *Abdomen* segmento secundo tertio longiore.

One of the numerous *Cryptorhynchus*-forms, which, without any salient characters, seems isolated by its facies from all others; in mere outline it slightly resembles *Mæmactes*.

Diaporesis distincta.

D. anguste elliptica, picea, squamis fulvo-brunneis vestita; elytris maculis duabus conspicuis, apiceque albis. Long. 4 lin.

Hab. Chontales.

Narrowly elliptic, pitchy, clothed with yellowish-brown scales, each elytron with a conspicuous white spot before the

middle and away from the suture, the apex also white; rostrum stout at the base, where it is also very roughly punctured, beyond smooth and glossy; antennæ ferruginous, the second and third joints of the funicle elongate, the latter the shorter of the two; prothorax as long as broad, rounded at the sides, not contracted at the base, coarsely punctured, and with an abbreviated median ridge; the elytra seriate-punctate, punctures subquadrangular and approximate, the intervals granuliform; body beneath with pale greyish scales.

Piazurus stellaris.

P. breviter ellipticus, fusco-velutinus, supra silaceo-guttatus; rostro glabro, basi subbisulcato; corpore infra nitide nigro, segmentis tribus intermediis abdominis ad latera dense silaceo-squamosis. Long. 5 lin.

Hab. Sarayacu.

Shortly elliptic, covered with a brown velvety pile; rostrum dark pitchy, the base lightly marked with two diverging grooves; antennæ ferruginous, the second joint of the funicle considerably longer than the third; prothorax subconical, sides slightly rounded, scutellar lobe emarginate, the disk with from four to six silaceous spots; scutellum rounded in front, somewhat produced behind, and covered with silaceous scales; elytra oblong cordate, finely striate, the apex of each obliquely truncate, above with from twelve to sixteen well-defined small silaceous spots, three principal on each side the suture, the posterior only approximating to it; body beneath glossy black, sides of the sterna and three intermediate segments of the abdomen at the sides covered with silaceous scales.

The spots vary in size and sometimes in number. Its only near ally is the following.

Piazurus lætus.

P. late ellipticus, olivaceo-velutinus, supra niveo-guttatus; rostro glabro, basi albo-squamoso; corpore infra nigro, nitido, lateribus dense silaceo-squamosis. Long. 4 lin.

Hab. Ega.

Differs from the preceding in its rich olive-green pile with snowy-white spots; scutellar lobe entire; the elytra much shorter, broader in proportion, and less convex, and the sides of the sterna and abdomen entirely covered with scales.

Piazurus sacer.

P. ellipticus, flavo-brunneo-squamosus; elytris pone medium plaga cruciformi albo-marginata ornatis. Long. 5¼ lin.

Hab. Ega? (Amazon).

Elliptic, closely covered with yellowish-brown pile, the elytra with a large dark brown patch behind the middle; rostrum strongly grooved at the base and irregularly punctured; antennæ ferruginous, second joint of the funicle nearly twice as long as the third; prothorax conical, the sides with one or two dark brown stripes, scutellar lobe entire; scutellum rounded, covered with a silaceous pile; elytra slightly convex, oblong cordate, the apex rounded, seriate-cordate, the "seventh" interstice sharply raised, behind the middle a large dark brown cruciform patch indefinitely bordered with white; body beneath and legs dull brown with scattered greyish scales.

This species may be compared to *P. phlesus*, which is much broader, and, *inter alia*, has the second and third joints of the funicle of equal length.

Piazurus diversus.

P. oblongo-ovatus, tuberculatus, squamis nigris silaceo-variis obsitus; antennis funiculo articulo secundo tertio fere triplo longiore; elytris singulatim apice oblique truncatis. Long. $3\frac{1}{2}$ lin.

Hab. Macas (Ecuador).

Oblong ovate, tuberculate above, and covered mostly with black scales and setulæ; head with a large, round, deeply excavated depression above; rostrum glossy brown, the base somewhat gibbous; antennæ ferruginous, second joint of the funicle nearly thrice as long as the third; prothorax transverse, rounded at the sides, a strongly marked gibbosity in the middle; scutellum rounded, covered with silaceous scales; elytra very gradually narrowing from the base, the surface very unequal, seriate-punctate, the interstices raised, with several small glossy granules on them, the base of each with two tubercles and another behind the middle, also a line of granuliform tubercles externally, each tubercle bearing a silaceous scale; body beneath and legs with rufous-brown scales; posterior femora very large.

Allied to *P. ostracion*, from which it is easily differentiated by the characters of the funicle, elytra, &c. The excavation on the head occurs in other species, but I am not sure that it may not be sexual.

Baris magister.

B. late ovata, glabra, nigra, nitida; elytris ferrugineis, interrupte striatis; rostro brevi, fortiter arcuato. Long. 7 lin.

Hab. Roraima (Guiana).

Broadly ovate, entirely smooth and glossy, black; the elytra

ferruginous; head and rostrum minutely punctured, the latter short and strongly curved; antennæ short and rather slender, the club small; prothorax very transverse, suddenly narrowed anteriorly, finely and remotely punctured, scutellar lobe truncate; scutellum broadly transverse; elytra moderately convex, interruptedly striate, the deeper parts punctiform, oblong, black, the interstices impunctate, apex broadly rounded; body beneath and legs glossy black.

A fine and very distinct species which may be placed in the same group with *B. catenulata.*

Baris fervida.

B. breviter ovata, glabra, cupreo-aurea; rostro crasso, brevi, fortiter arcuato; elytris lineatim striatis. Long. $4\frac{1}{2}$ lin.

Hab. Chontales.

Shortly ovate, rich coppery gold; head moderately punctured; rostrum short, much curved; antennæ black, club large, ovate, pointed; prothorax gibbous, transverse, contracted anteriorly, coarsely and closely punctured, scutellar lobe produced; scutellum rounded, but somewhat pointed behind; elytra depressed and irregular above, with linear clean-cut striæ, the interstices rather strongly punctured; body beneath and legs greenish copper.

Colour, stout strongly curved rostrum and sculpture, will distinguish this species from its allies, such as *interpunctata, metallica,* &c.

Eurhinus cupripes.

E. late ovalis, nitidissime viridis; capite, rostro pedibusque purpureo-cupreis; scutello valde transverso; elytris fere obsolete punctatis. Long. 3 lin.

Hab. Mexico.

Broadly oval, brilliantly green above and beneath, the head, rostrum, and legs a rich purple-copper; antennæ black; prothorax impunctate; scutellum very broad, rounded behind; elytra seriate-punctate, but, except the sutural row, the punctures nearly obsolete.

Allied to *E. cyaneus*, but narrower and differently coloured.

Eurhinus eximius.

E. late ovalis, nitidissimus; capite prothoraceque cupreo-aureis; elytris cyaneis; rostro a capite separato; funiculo elongato. Long. $2\frac{3}{8}$ lin.

Hab. Parana.

Broadly oval, very glossy; head and prothorax copper

with a golden tint; elytra a rich blue; rostrum purplish, distinctly sulcate at the base *above* the eyes, much longer than the prothorax; antennæ pitchy; funicle with the two basal joints elongate, the remainder gradually shorter, the last two only transverse; prothorax nearly impunctate; scutellum transverse; elytra linearly striate, the interstices obsoletely punctured; body beneath and legs greenish.

The groove at the base of the rostrum and the elongate funicle are characters at variance with the rest of the genus, but in all other respects they agree.

Ganymela.

Oculi rotundi, depressi. *Rostrum* mediocre; *scrobes* laterales, breves; *antennæ* basi rostri insertæ, scapus brevis, articulo primo crassiusculo. *Prothorax* transversus, basi subbisinuatus. *Elytra* normalia. *Coxæ* anticæ approximatæ. *Femora* infra serrata; *tibiæ* breves, anteriores arcuatæ; *tarsi* latiusculi, articulo ultimo parvo; *unguiculi* connati. *Propectus* perparum canaliculatum. *Abdomen* sutura prima fere obsoleta.

According to Lacordaire the approximation of the anterior coxæ is the principal character which separates the "Madopterides" from the rest of his "Baridiides." But the genera of the former group are composed of long narrow species very different from the one before us, for which he would probably have constituted another "groupe." The genus is remarkable for the basal position of the antennæ and the serrated femora.

Ganymela nitida.

G. fusco-castanea, nitidissima: prothorace subquadrato, apice subito constricto; elytris supra inæqualibus, lineatim striatis. Long. 4 lin.

Hab. Panama.

Dark chestnut-brown, very glossy; rostrum shorter than the prothorax, moderately curved, with oblong scattered punctures; antennæ ferruginous, third joint of the funicle longer than the second; prothorax convex, the sides straight but gradually widening to the base, the disk remotely and minutely punctured; scutellum concave, truncate behind; elytra broader than the prothorax, the surface irregular, narrowly striate, femora moderately stout and having on the anterior pair 6–8 serratures beneath, smaller serratures on the intermediate and posterior; tarsi with a yellowish tomentum beneath.

Eutoxus corax.

E. ellipticus, niger, nitidus; rostro modice elongato, a basi arcuato;

prothorace utrinque omnino rotundato, leviter vago punctato. Long. $5\frac{1}{2}$ lin.

Hab. Sarayacu.

Elliptic, glossy black; rostrum shorter than the elytra, curved from the base, striate-punctate beyond the insertion of the antennæ; prothorax with the sides rounded throughout, the narrow collar at the apex excepted, rather minutely punctured; elytra more gradually narrowed from the base, finely punctate-striate; body beneath punctured throughout.

In its only congener, *E. reflexus*, the rostrum is longer than the elytra and much more slender, the curved portion being chiefly confined to the apical half; the prothorax is somewhat incurved behind the apex, and the elytra are more rapidly narrowed behind.

XXXVIII.—*Striated Muscles in Echinida.* By Frank E. Beddard, M.A., F.R.S.E., Prosector to the Zoological Society.

The April number of this journal contains (p. 388) a translation of a short note by Dr. Otto Hamann on striated muscles in the Echinida, which is evidently preliminary to the publication of a more detailed memoir; the gist of it is contained in the following sentences:—

"In Holothuriæ and Asterida I have sought in vain for transversely striated fibres, but I have now succeeded in finding them in the Echinida. They occur, however, only in a few places, and, indeed, in places where a sudden, rapid, and energetic contraction has to take place. The largest forms of pedicellariæ, the *pedicell. tridentes* s. *tridactyles*, are best fitted for examination. . . . . The musculature which moves the three arms . . . . distinctly shows transverse striation."

The author does not refer to any previous investigations on the subject, but makes his statements in such a way that any one reading the note would naturally assume that Dr. Hamann himself had made the discovery referred to.

As a matter of fact the above-quoted observations are not new, but simply confirm the results of an investigation by Mr. Patrick Geddes and myself. Our paper, "On the Structure of the Pedicellariæ and Muscles of *Echinus sphæra*," was published in vol. xxx. of the 'Transactions of the Royal Society of Edinburgh;' a brief abstract had been previously com-

municated to the French Academy ('Comptes Rendus,' 1881, Feb. 7, p. 308), and this was translated into the Ann. & Mag. Nat. Hist. (vol vii. ser. 5, 1881, p. 275). The research was completed at M. de Lacaze-Duthiers's laboratory at Roscoff, and a notice of the main results was published, simultaneously with the detailed communication to the Royal Society of Edinburgh, in the 'Archives de Zoologie Expérimentale' (tome x. "Notes et Revue," p. xvii). In the 'Transactions' paper the muscles of the pedicellariæ—those which serve as adductors of the valves—are figured (pl. xx. fig. 2), and the fact that they are striated is noted in the text (p. 387) of that paper as well as in the other communications on the subject.

Since that was written I have had the opportunity, at the Zoological Station of Naples, of studying the structure of the pedicellariæ in other Echinoids, and have found, as might be expected, that there is an entire similarity. In *Echinus melo* and *Echinus brevispinosus* the muscles of the "ophiocephalous" pedicellariæ are striated; in the former species I also observed a striation in the "gemmiform" pedicellariæ, which Mr. Geddes and I were unable to prove in the case of *E. sphæra*. In *Toxopneustes lividus* both the "tridactyle" and "ophiocephalous" pedicellariæ contain striated muscles. Finally, in a species of *Arbacia* which is very abundant at Naples the "ophiocephalous" pedicellariæ show striations. The above statement must not be understood to imply that the other forms of pedicellariæ not mentioned—for example the "gemmiform" pedicellariæ of *Echinus brevispinosus*—are without striated muscles; I simply take this opportunity of noting a few observations made by me at Naples in the year 1881, which are too fragmentary to be worth publishing in detail.

It is not always possible to detect the striations in the pedicellaria-muscles; and the failure of previous observers to detect them is no doubt due to imperfect methods of preservation. Mr. Murray kindly allowed me to examine a number of the 'Challenger' Echinoidea, with a view to an investigation on the comparative anatomy of the pedicellariæ; in no instance, however, did I succeed in seeing any striation on the muscles, which is probably owing to the fact of their preservation in alcohol. The reagents which Mr. Geddes and I found to be best for displaying the striation are mentioned in our paper.

In our paper on *Echinus sphæra* the existence in the ophiocephalous pedicellariæ of certain remarkable skeletal structures was referred to; these have the form of flat plates of elastic tissue formed of a number of about equally-sized

fibres, which anastomose with each other and form a highly complicated structure (*loc. cit.* pl. xx. figs. 10, 11). These also exist in the tridactyle pedicellariæ, but are much smaller and hard to discover in teased preparations. I have since found these structures in other species of *Echinus* in the same situation and in the ophiocephalous pedicellariæ of *Arbacia*. It would be interesting to have some further information as to the nature and distribution of these very curious structures.

XXXIX.—*Description of a hitherto unnamed Butterfly from Madeira.* By Arthur G. Butler, F.L.S. &c.

Whilst incorporating the Zeller collection of Pierinæ with our Museum series I came across two specimens of a species from Madeira labelled as the *P. cheiranthi* of Hübner, but differing considerably from that species.

On referring to the Wollaston cabinet of Madeiran insects I found eight specimens of the same species; proving its constancy. I therefore propose to call this butterfly

Ganoris Wollastoni, sp. n.

Intermediate between *G. cheiranthi* and *nipalensis*, differing from the former in its inferior size, paler and greener tint in both sexes, the female without distinctly yellow secondaries and with the black spots smaller and less distinctly confluent, the three median veins all blackened beyond the black spots. Under surface quite different from that of either species, the tint of secondaries and apex of primaries being greener even than in *G. brassicæ*. From *G. nipalensis* it differs in having a black longitudinal dash on the second median interspace on the upper surface of the male, and the black spots in the female more or less united by a sinuated blackish streak from the inner margin; all three median branches blackened (whereas in *G. nipalensis* only the second and third are black); the secondaries below sulphur-yellow, densely irrorated with blackish scales, the costa and apical area of primaries pale sulphur-yellow; the black spots with two black dots between them. Expanse of wings, ♂ 67 millim., ♀ 72 millim.

Madeira (*T. V. Wollaston*).

XL.—*Descriptions of Sponges from the Neighbourhood of Port Phillip Heads, South Australia, continued.* By H. J. Carter, F.R.S. &c.

[Continued from p. 127.]

Order VII. HEXACTINELLIDA.

Families.	Groups.
1. *Vitreohexactinellida*	1. Patulina. 2 Tubulina. 3. Scopulifera.
2. *Sarcohexactinellida*	4. Rosettifera. 5. Birotulifera.
3. *Sarcovitreohexactinellida*	Only one species known, viz. *Euplectella cucumer*, Owen.

This arrangement, based on a hasty study of almost all the then-known species of Hexactinellida, whose result may be seen in the 'Annals' of 1873 (vol. xii. p. 349, pls. xiii. to xvii.), will be found towards the end of my Classification (*ib.* 1875, vol. xvi. pp. 199 and 200), accompanied only by the names of the species respectively which illustrate the groups that have been more particularly noticed in the paper to which I have just alluded. Two more species were described and illustrated in 1877 ('Annals,' vol. xix. p. 122, pl. ix.) and two or three more in 1885 (*ib.* vol. xv. pp. 387–406, pls. xii. to xiv.), among which is the famous *Farrea occa*, now deposited in the British Museum. Those which have been described by others since the date of publication to which I first alluded, and which are very few in number, must be sought for by the student himself.

Unfortunately all that I have stated has been from dry specimens, and the only instance worth mentioning in which the structure of the soft parts has been described from a Hexactinellid sponge preserved in the *wet* state is the description by Prof. Dr. F. E. Schulze of a specimen of *Euplectella aspergillum*, which he received in "January 1880 from the 'Challenger' Office, Edinburgh," for this purpose ('Challenger' Reports, Sponges Hexactinellidæ, pl. A). To mention the author's name is a sufficient guarantee for the authenticity of this kind of work, in which he has never been equalled and can, with his power of delineation, hardly be surpassed. Referring the student to the paper itself, I would only here observe that, at p. 6 of the "separate copy" which the author

kindly sent me, it is stated that the ampullaceous sacs (Geisselkammern), which have a peculiar elongated shape and are placed side by side, with their apertures directed towards the centre of the exhalant canal, like the radial chambers of *Grantia ciliata* around its cloaca, average "about 100 μ" in length and "about 60 μ" in breadth; while those which he had previously described and illustrated in *Spongelia* (Zeitschrift f. wiss. Zoologie, Bd. xxxii. p. 134, Taf. viii. fig. 5) are stated to have averaged "von 0·06–0·1 mm." in diameter. The radial chambers of *Grantia ciliata* vary of course with the size of the specimen, but may be 1-24th in. long by 1-60th in. in diameter and even more, that is about 1·0159 by ·5079 millim., so that there is a great difference in size between the ampullaceous sac of *Euplectella aspergillum* and its apparent analogue in *Grantia ciliata*, however much in other respects they may resemble each other.

As there are no specimens of the order Hexactinellida in Mr. Wilson's collections, let us pass on to the next, viz. the Calcarea, wherein will be included not only the specimens which came "from the neighbourhood of Port Phillip Heads," but those also which were subsequently obtained by Mr. Wilson from "Western Port," about 15 miles to the westward.

Order VIII. CALCAREA.

Here I cannot premise as heretofore any classificatory arrangement of the species of this order, as I had not studied them sufficiently for this purpose when my Classification of the Spongida generally was published ('Annals,' *l. c.*); and not having done much more since in this way I must still, as I did then, recommend the student to study Häckel's work entitled 'Die Kalkschwämme' (eine Monographie in zwei Bänden Text und einem Atlas mit 60 Tafeln Abbildungen, 1872), to which, however, I must now add the judicious criticism on this work of Dr. N. Polèjaeff, in his "Report on the Calcarea collected by the 'Challenger' Expedition" ('Challenger' Reports, Zoology, vol. viii. pt. xxiv. 1883), and his proposed alterations, throughout which he has not forgotten the respect due to Häckel nor the advantage he has derived from that first and brilliant step into this field of inquiry which Häckel has put forth in 'Die Kalkschwämme.' Doubtless there are shortcomings in every man's work, and thus every man's work helps primarily to supply them; hence, as Dr. Polèjaeff properly remarks, "every one is son of his time" (Report, p. 6).

The calcareous sponges were divided by Häckel into three families, viz. "Ascones, Leucones, and Sycones," which, for very satisfactory reasons, Dr. Polèjaeff (Report, p. 22) has reduced to two divisions, viz. "Homocœla and Heterocœla," the former including the single family of Asconidæ (Ascones), and the latter those of the families Syconidæ (Sycones), Leuconidæ (Leucones), and Teichonidæ (Teichone, Teichonellidæ),—the chief differences between the two being that in the division Ascones or Homocœla there is apparently no parenchymatous tissue, that is, the sponge is almost entirely reduced in structure to a mere tube whose wall hardly amounts to more than a thin layer of spicules held together by and supporting the sarcode (syncytium, H. in part) which contains the soft portions of the species, but branching, anastomosing, and rebranching continually during growth, at length may reach a more definite form; while in the Heterocœla the tissue supporting the soft parts fills up as it were the spaces between the bends of the tortuous tubulation in the Ascones, and thus produces a massive sponge like *Teichonella prolifera*, which in structure closely approaches an ordinary non-calcareous sponge. I have said "as it were," because the "tubulation" does not exactly represent the excretory canal-system of *Teichonella prolifera*, which is dendriform, while that of a tubular Ascon is more or less of the same calibre throughout. However, this broad distinction will do for the present, as I shall have to return to the subject more particularly hereafter.

But in so far as many of the Sycones are as much reduced to a simple tube in their structure as many Ascones, so I shall transpose Häckel's primary or family divisions as Dr. Polèjaeff has done, by placing the Sycones before the Leucones and the Teichonellidæ last; thus we shall have an uninterrupted evolution in structure from the simple tube in the Ascones to the most complicated form of that in the Teichonellidæ, or, at least, *T. prolifera*, for we shall find by-and-by that it will be necessary to place *T. labyrinthica* among the Sycones, as its structure is almost precisely that of *Grantia compressa*.

Meanwhile it is necessary to begin by defining what a calcareous sponge is, and this may be done by stating that it is a spiculiferous sponge in which all the spicules are calcareous.

After which it may be added that it possesses *no fibre*, which, together with its tender structure generally and the delicate structure of the excretory canals, renders its tissue more or less *fragile* in every instance.

To examine a calcareous sponge for description it is necessary to sectionize the specimen, so that one part or half may be dried and the other kept wet, *i. e.* in a preservative fluid. Thus the sections may be either partial or general, one or more depending on the amount of material at command; but under any circumstances there must be dried sections of the specimen as well as wet for this purpose.

Where time is not an object, as it is with me, for I may have little left, *microscopic* sections of dyed portions should be made, since without this a complete description of no sponge can be written. *My* descriptions therefore will be incomplete so far as this goes; but it is to be hoped that they will fulfil their purpose in other respects, that is in providing an introduction to this inquiry for those who may take it up hereafter.

At first, in the description of a calcareous sponge, the form generally of the specimen should be notified, and, if possible, an accurate sketch of the natural size *recorded* before it may be disfigured by the sectionizing. Then the colour, both in the fresh and dried states, should be mentioned. After this the surface described, generally and in detail. The pores noticed, and also the vent or vents, as the case may be, followed by the cloaca. All this may be regarded as belonging to the *general* form, outwardly and inwardly. After which the internal structure, viz. that which is situated between the skeletal layer of the surface on the outside and that of the cloaca on the inner side, should be described in detail. Finally the spiculation or spicules, generally and particularly, followed by the size of the specimen, its habitat, locality, and any further observations that may be desirable. At least this is the plan that will be adopted in my descriptions.

In describing the "form" it may be necessary to use the words "individualized" or "agglomerated," the former meaning single or complete in itself, the latter in plurality and more or less sunk into a general mass. Again, the former may be "solitary," that is when alone, or "social," when accompanied by others of the same kind, young or old. Of course the "description" of the "form" can only apply to the specimen in hand, unless there are sufficient examples to afford an average.

In the matter of colour, which is generally the same, I would premise here that this is some shade of "white" or "sponge-brown," approaching more or less to that of snow, as in *Leuconia nivea*, Bk. (*Leucandra nivea*, H.), and that when *dry* the exposed parts, viz. the surface and the cloaca, are always whiter than the internal structure, on account of

the greater abundance of sarcode in the latter (where the ova are generally seen), which, when dry, assumes a sponge-brown colour. These observations are premised to avoid unnecessary repetition in the text, so that hereafter in the descriptions the colour may not be noticed, unless differing from that above mentioned.

The "structure of the surface" or cortical portion needs no remark beyond the fact that the holes of the cribrated dermal sarcode, *i. e.* the *pores*, are generally much larger than in the non-calcareous sponges; then the spongozoa are nearly double the size also, and in the fresh state so large that they may often be seen to contain the *green zoospore of an alga*, which, by its colour, contrasts strongly with the translucent white of the spongozoon, thus favouring the view that it was taken in for nourishment, just as when fed with carmine or indigo *paint* the gummy part appears to be retained for the same purpose and the colouring-matter rejected, as I have long since shown ('Annals,' 1857, vol. xx. pp. 28 and 29). In short, as regards this subject I know of no other means of ascertaining these facts satisfactorily than by watching the development of a sponge under water, that is while growing, which can only be done in *fresh* water, with the gemmule or statoblast of a living *Spongilla*, as I have mentioned (*op. et loc. cit.*); for here there is no tearing to pieces or interfering with the sponge, which may be transferred to the field of the microscope (in the watch-glass in which it may be growing) for observation, as long and as often as the student thinks necessary, while a very high power (immersed of course) may be brought to bear upon it during the time that a solution of the carmine paint is added to the water in its neighbourhood. I do not mean to state that this is the only course by which the sponge is nourished, for Lieberkühn has long since shown that an Infusorium may be taken in by the general substance of a sponge, and there digested in a similar manner to the nutritious fragments which the Infusoria themselves employ for this purpose, ex. gr. *Amœba*.

The terms "cortex" and "structure of the surface" will be often used synonymously; but it should be remembered that generally the surface-layer is so thin that it hardly deserves this name, since it is only in one species, viz. *Hypograntia infrequens*, which will be hereafter described, that I have found this layer so thick as to deserve the name of "cortex," and of this it is impossible to get a better idea than that conveyed in Polèjaeff's illustration of *Ute argentea* (*op. cit.* pl. iv. fig. 8).

Returning to our vocabulary: I have used the term "vent"

for what is generally called the "mouth" or "osculum" in a calcareous sponge, after the manner that this would be applied to a sack; and the word "cloaca" for the cavity to which it leads explains itself; while the apertures on the surface of the latter will be termed "holes," and that or those, as the case may be, which are seen to open into them, more or less below the surface, the "openings," that is of the chambers or canals of the internal structure or that of the wall; the whole of which is precisely similar to corresponding parts in the non-calcareous sponges.

For the interval between the surface or cortex of the body and that of the cloaca the term "wall" will be adopted; its structure consists of empty spaces accompanied by a variable quantity of minutely cancellated tissue. The former will be termed tubes, chambers, or canals, according to their shapes respectively. Thus they will be called "radial chambers" (radial tubes, H.) when they are more or less cylindrical or prismatic, straight and extending directly across the "wall" horizontally, from under the pores on the surface to under the holes of the cloaca respectively, as in *Grantia ciliata*, Bk.; or they may be "subradial," that is more or less branched under the same circumstances, as in our *Hypograntia*; or with no appearance of radiation at all, as in our *Heteropia*; or with the empty spaces canalicular and branched, tree-like, as in *Teichonella prolifera*; while the minutely cancellated tissue which accompanies them will be termed "parenchyma."

Again, as regards the form and arrangement of the spicules in the structure of the wall; this, in his Sycones, has been divided by Häckel into "articulate" (gegliederte) and "inarticulate" (ungegliederte), that is respectively where the skeletal structure of the radial chambers (tubes, H.) is entirely composed of a number of small radiates about the same size, or where it is formed by the simple extension across the wall of the long shafts of large radiates, whose heads support the cortex or dermal structure on one side and that of the cloaca on the other, thus leaving horizontal intervals between them which correspond to the radial chambers; or these two forms of skeletal structure may be mixed, *i. e.* where one portion of the radial chamber is "articulated" and the other "inarticulated;" but in all cases the sarcode tympanizing the intervals of these spicules to complete the chamber is pierced by intercommunicating *pores*; while in the subradial or branched chambers and the still further divided forms, up to that which is dendritic, the chambers, now as it were become canals, are rendered continuous with one another by larger or smaller holes of intercommunication, according to the species and the degree

of subdivision of these canals, that is, of course, where the latter are very small the holes are in proportion.

It may also be observed that the chambers immediately under the pore-dermis are often much more dilated than further in, thus resembling the "subdermal cavities" of the non-calcareous sponges; and a similar dilatation may often be seen immediately under the cloaca, which, to a certain extent, may account for the plurality of openings in the wall-structure appearing through the holes of the latter, as will be noticed hereafter in the descriptions of the respective species where this presents itself; I say "to a certain extent," because where the holes in the cloaca are in proportion to the number of radial chambers, as in *Grantia ciliata* &c., this cannot occur.

Lastly we come to the "spiculation," *i. e.* a description of the different forms of spicules, which are generally found to be more or less constant in particular parts. Thus, beginning with the acerates, it will be noticed that those which fringe the vent or mouth of the cloaca present a peculiarly glistening aspect *en masse*, which, when they are separate, is found to depend on their long, straight, cylindrical, delicate form, closely resembling "spun glass," and these, similarly pointed at each end and arranged like a palisading around the *inside* of the mouth, where their fixed ends are on a level with the surface of the cloaca and their free ones project more or less beyond the mouth or vent, will be called the "peristome;" on the other hand, when there are *none*, and this feature is consequently absent, the mouth will be called "naked." At the same time it should be remembered that the two states may occur in a group of the *same* individuals, so that the presence or absence of the "peristome" must not be always regarded as an infallible distinction.

Again, the acerates may be more or less scattered over the surface either echinatingly or altogether imbedded in it *longitudinally*, when they will generally be found to be much stouter, more or less curved equally throughout, or more in one half than the other, which is generally the outside one; also more or less equally fusiform, in which case the thickest part is outwards and the other more or less sunk into the wall. Occasionally the outer end is "lanciform," in a line with the shaft, or bent to one side, like a "fixed bayonet" on a musket, and limited in its extent by a more or less prominent annular inflation, which extends obliquely or circularly across the shaft at the point of union; or the outer end may be more or less sharply curved or club-shaped &c.

Lastly, there is often a minute straight or sinuous acerate

with more or less lanceolate or, rather, "fixed bayonet" end, like that just described, sometimes serrated, with which the cribriform sarcode of the dermis is charged. Taking the place of the flesh-spicule in the non-calcareous sponges, and thus also strengthening this structure, while it acts in combination with the sarcode as a kind of cement in binding down the larger spicules of the surface generally, it has been termed by Häckel "Stäbchen-Mörtel." Hence these spicules may be termed "mortar-spicules," so that when this term is used the reader will know what is meant by it. This form again sometimes attains a larger size, when, as is the wont of the dermal acerates generally, they become mingled with the internal ends of the spicules of the mouth and thus form part of the proximal end of the peristome.

But the staple and, therefore, most characteristic spicule of most calcareous sponges is a "radiate," which may be regular or irregular; that is to say, when the arms or rays are all equal in size and all separated from each other at equal angles it may be termed "regular," and when the reverse "irregular."

The radiates, again, may be divided into three-armed and four-armed spicules, *i. e.* triradiates and quadriradiates, which may be more or less equally mixed together according to the species or their position in that species.

Noticing the triradiates first, it may be observed that they are generally more or less elevated in the centre, so that if on a level surface with the points of their arms downwards they would rest on these points, a feature which attains its maximum in the peculiar form that characterizes the surface of *Clathrina tripodifera*, as will be more particularly mentioned hereafter. It may also be observed that when the triradiates depart from their "regular" form they for the most part become more or less bow-and-arrow shaped (whence they have been termed "sagittal"), in which two of the arms may be variously expanded laterally in a more or less curved or undulating form, backwards or forwards, while the third remains more or less straight, and hence will be termed the "shaft." Under this form they may be generally small or generally large. Thus, as before stated, when generally small and numerous they form the skeletal structure of the radial tube or chamber in the Sycones, which has been termed "articulated;" while when large, with long shafts, the latter alone extending across the wall simulates that which has been called "inarticulated."

The "sagittal" form appears to be often used for binding down the subjacent spicular structure, and, following it up-

wards from the surface of the cloaca, this becomes particularly striking and beautiful at the base of the peristome, where the arms are not only expanded almost perpendicularly across the lower ends of the spicules of the peristome, like cross bars in a palisading, but, to still further extend their use, are absolutely flattened vertically, while the shaft remains more or less aborted, thin, round, and directed backwards in a line with the spicules in the layer of the peristome.

The quadriradiates, on the other hand, do not differ from the triradiates except in the addition of what is termed a fourth arm; but inasmuch as this is for the most part different in form from any of the rest, it has been termed by Dr. Bowerbank the "spiculum" or "spiculated ray" (Mon. Brit. Spong. vol. i. p. 241, pl. iv. figs. 85 and 86); we shall call it the "fourth ray." It may be larger or smaller, longer or shorter than either of the other rays, curved or straight, simple or ensiform, according to the species and its position in that species, situated perpendicular to the rest of the rays or inclined forwards in the sagittal forms. In the body of the cloaca, where these spicules constitute a characteristic feature, the fourth arm, which projects into the interior, is perpendicular to the other three (which are fixed in the surface of this cavity), with the curve *always* directed *towards* the mouth, and in this form they may be traced more or less into the canals leading into the cloaca. On the other hand, when the quadriradiate is large or constitutes, from its size and predominance, the greater part of the spiculation, as in *Leuconia Johnstonii*, Carter (*Leucandra Johnstonii*, H.), it may be more or less like the rest; but under these circumstances this spicule may *in situ* be frequently distinguished from the triradiate by presenting a dark triangular space in the centre of the other three rays, whose angles are coincident with those of the triradiate portion, and whose darkness arises from the rays of light at this part passing *through* the surface instead of being reflected from it; while in the triradiate there is no "dark space" visible unless the spicule be viewed laterally, when a similar thing happens through the position of the third ray; but its shape is quadrangular and more or less concave at the sides, like an hour-glass; hence, as these spicules lie *in situ* on the surface in *L. Johnstonii* &c., where the fourth ray is directed inwards and the triradiate portion lies flat on the surface, the "dark space" is only seen in the former.

Among the triradiates may be mentioned in particular a form very much like a "tuning-fork," in which the arms are projected forwards almost parallel to each other and closely

approximated, whilst the shaft is continued backwards in the opposite direction. The interest attaching to this spicule is that it was first noticed and represented by Dr. Bowerbank in a mounting from a calcareous sponge, found at or near Freemantle, at the south-western angle of Australia (Phil. Trans. 1862, pl. xxxvi. figs. 18 and 19, repeated in his Mon. Brit. Spongiadæ, vol. i. p. 268, pl. x. fig. 237), of which Dr. J. E. Gray made a genus under the name of "*Lelapia*," and a species under that of "*L. australis*" (Proc. Zool. Soc. 1867, p. 557), and which Dr. G. J. Hinde, F.G.S., discovered in two fossilized calcareous sponges, respectively named *Sestrostomella rugosa* and *S. clavata* ('Annals,' 1882, vol. x. p. 185), confirmed by myself in a specimen of the former from the Jura; and, further, that I have now found it abundantly in a recent calcareous sponge from the neighbourhood of "Western Port," Victoria, S. Australia, among Mr. Wilson's collection from this part, as will be seen hereafter, when it will be found to be described under Dr. Gray's name, i. e. "*Lelapia australis*." Häckel observed the same form in his *Leucetta pandora*, also from the south coast of Australia (*op. cit.* 'Atlas,' Taf. 23. fig. *h*), and in his "connective variety" of *Leucortis*, viz. *Leucandra pulvinar* (*ib.* vol. iii. p. 166), from the western coast of Australia &c.; but in neither is the spiculation the same as in our species, which, as just stated, will be called "*Lelapia australis*."

As regards the *measurements* of the spicules, I would premise that, where given, they are intended to represent the largest size of their kind, or the size of the most characteristic forms of the species *that I have seen*; for to go further would be only to multiply assumptions, since in the hasty observation of the minor radiates, which are by far the most numerous, it is difficult to find two which are exactly alike; besides, as I have before stated, the triradiate is always more or less raised in the centre, so as to become tripod-like, whereby it becomes next to impossible to measure *its* arms accurately. Hence, both in the smaller and the larger spicules, the measurements must always be taken as approximative; while they will for the most part be given in "6000ths" of an inch, that the student may realize their relative dimensions. I regret that I cannot go more into detail in this matter; but as stated above respecting the dyeing and making microscopic sections, which is a comparatively long process, it is to be hoped that what I am not able to do now may be supplied by others hereafter.

Also, to avoid unnecessary repetition in the text, I may at once state that, except in a few instances, neither the "habi-

tat" nor the "depth" will be mentioned, and the same with the "locality." For, in the first place, all calcareous sponges are marine; in the second place, most of the specimens that I have discovered among Mr. Wilson's collections have, as a matter of course, been *un*accompanied by their "depths," on account of their insignificant size; and, lastly, the "locality" being either "Port Phillip Heads" or "Western Port," about 15 miles further to the west, their neighbourhood may be considered the same from a natural-history point of view.

With these preliminary remarks let us proceed to the description of all the specimens of Calcareous Sponges that I have been able to find in Mr. Wilson's collections generally, beginning with that structure which seems to me most simple, viz. *Clathrina cavata*, and ending with the most complicated, viz. *Teichonella prolifera*. I have no further classification to offer, and therefore must refer the reader to the works of Häckel and Polèjaeff for this purpose, as before mentioned, my own being regarded as only a contribution to the subject. There are forty species, of which many are represented by several specimens, some of which are of considerable size, viz. 6 to 7½ in. in their longest diameters, and all in a good state of preservation—far exceeding in every way what is to be found on the British coasts.

[To be continued.]

XLI.—*On the British Weevers, the Bib, and the Poor-Cod.* By Prof. M'Intosh, M.D., LL.D., F.R.S., &c.

Two species of weever * have been described by most authors who have treated of the fishes of our own and continental countries, viz. the greater and the lesser weever. So far as previous and present examinations, however, can guide me, I am inclined to think there is a very close relationship between them; indeed it is possible that the one is only a young stage of the other, and that certain distinctions, such as the absence of spines above the orbit in the smaller form and its greater depth in proportion to its length, disappear with age. It is well known, indeed, that noteworthy modification in outline occurs during the growth of several fishes. Moreover, in the large form (greater weever) there is considerable variation, for instance, in the semi-membranous prolongation of the free

* *Trachinus draco*, L. (greater weever), and *T. vipera*.

margin of the operculum. The diversity in the pigment is easily explicable on other grounds than those of specific distinctness. Further, the fact that the smaller form is fertile at an early age is not altogether a reliable basis of separation. Besides, I have not been so fortunate as to secure the young forms of the so-called greater weever, while the young of the lesser weever have been familiar to me for many years—from an inch in length upwards.

The smaller form (lesser weever) frequents extensive sandy reaches, such as those off the west sands, St. Andrews, where it delights to bury itself in the sand, and is tossed on shore after severe storms at all stages. The larger form (greater weever), on the other hand, is found as a rule, especially if well grown, in deeper water. In this habit, however, it would only coincide with the larger forms of certain other species of fishes.

A perusal of Dr. Günther's accurate and careful remarks * on the two forms above mentioned strengthens the view just expressed.

The weevers are well known to fishermen from the wounds inflicted by their opercular spines. A most interesting account of the structure of the parts and the result of an experiment with the living form are given by Prof. Allman in a former number of this journal †.

In the standard works on fishes in our country, and in the literature of fishes generally since the time of Linnæus, the bib or whiting-pout and the poor- or power-cod are mentioned in close proximity. The latter is described as diminutive in size, seldom exceeding 6 or 7 inches in length, and less deep than the former when of the same length. The barbel on the chin is shorter, and there are minor differences in the length of the fin-rays and in the position of the anal fin.

In the most recent work on British fishes, viz. that of Mr. Francis Day, it would appear that the elaborate descriptions in regard to eyes, teeth, fins, scales, lateral line, and colours are not always satisfactory, since they fail to show the relationship existing between the adult and young stages apparently of the same species. The experienced author, indeed, observes, under the head of the Poor-Cod:—"Winther places *G. luscus* as a variety of this fish; but *G. minutus* is not nearly so deep in the body, while its vent is placed below the last rays of the first dorsal fin, and the free portion of its tail is more extended. I have not had an opportunity of investigating both sexes of these two species of fish." This remark

* Catalogue of Fishes (Brit. Mus.), ii. pp. 233 and 236 (1860).
† Ann. & Mag. Nat. Hist. ser. 1, vol. vi. pp. 161-165 (1841).

indicates some uncertainty on the subject, and my own experience of the species has now led me to conclude that what has been described as the poor- or power-cod (*Gadus minutus*) by several authors is only the young of the bib. Considerable change occurs in the outline of the fins as the adult condition is reached, and the pigment is also increased; but a large series from various parts of the British seas leaves little doubt as to the identity of the two forms.

It would appear that the confusion in regard to this species has partly arisen from an examination of preserved specimens. This is probably one of the reasons why they are separated in Dr. Günther's valuable and laborious Catalogue of the Fishes in the British Museum*.

It is remarkable that very few males were procured last season, and this out of a large number of examples obtained for examination at the marine laboratory.

XLII.—*Early Stages in the Development of the Food-Fishes.* By Edward E. Prince, St. Andrews Marine Laboratory†.

During the spring and summer of last year (1885) the ova of about twenty species of shore and deep-sea Teleosteans were studied in the Marine Laboratory, St. Andrews. Of these about half were carried through the embryonic stages in the tanks of the laboratory, and several species have, for the first time, been studied and the embryos reared at St. Andrews. Six of the species referred to have claimed special attention on account of their economic importance, and the following observations refer mainly to these, viz.:—*Gadus merlangus*, *Gadus æglefinus*, *Gadus morrhua*, *Trigla gurnardus*, *Pleuronectes flesus*, and *Pleuronectes limanda*.

So far as investigations at present show, this remarkable fact has been established—that, with the notable exception of the herring, the ova of those marine fishes which are of chief commercial value are pelagic, and when mature present almost identical features in structure and appearance. In the course of development likewise few points of dissimilarity appear; but the warning expressed by Prof. Ray Lankester is none the less just, that each form should be investigated in detail, for "in embryology the practical lesson is daily being more

* Vol. iv. pp. 335, 336 (1862).

† Communicated by the Author, having been read at the Aberdeen Meeting of the British Association (Section D), September 1885.

and more impressed upon naturalists, that the assertion of generality throughout a class or phylum of organisms for a phenomenon observed only in two or three, or even more members of that class, is an exceedingly risky proceeding"*. Each species has been studied separately and continuously in the laboratory, and much material has been accumulated, which has yet to be exhaustively worked out, and the present paper is chiefly of the nature of a preliminary account.

Spermatozoa.

The spermatozoa of the different species present no special features and are not readily distinguished from each other. They exhibit, as usual, an enlarged portion or head, which is almost perfectly spherical, with a smooth, refractive, cortical portion and a central translucent part. The vibratile filament, or "tail," is very long, delicate, and homogeneous. They issue from the fully developed male as a whitish fluid, of a rich creamy consistency, and they become diffused very rapidly in sea-water. A large quantity of milt is produced, and it is often expelled with great force. The vitality of the spermatozoa is considerable; a small quantity exposed upon a slide for three hours exhibited active movements at the end of that time.

The Ovarian Ovum.

When approaching maturity the ovum gradually loses the opacity which characterizes it for some time after protrusion from the ovarian stroma. The capsule is disproportionately thick and very pliant; but it is structureless and destitute of the radiating canals or striæ seen in many ova. Minute spherules and refrangible particles are abundant in the fluid contents, and the *vesicula germinativa* is comparatively large and usually shows a very distinct nucleolus. The intra-ovarian eggs do not ripen simultaneously, and in *T. gurnardus* especially few ova appear to mature at the same time, so that the spawning-process would appear to be protracted and intermittent, less so in the Gadidæ and still less prolonged in the Pleuronectidæ.

The Mature Ovum.

The mature ovum is more or less spherical, and when healthy has an almost crystalline transparency. It exhibits (1) a deutoplasmic globe, chiefly food-yolk, homogeneous and colourless, and destitute of large oil-globules, save in the case of *T. gurnardus*, which possesses a single spherical oil-

* Quart. Journ. Micr. Sci. vol. xvi. p. 377.

globule of a pale salmon-tint; (2) a delicate cortical film of protoplasm, in which small vesicles and granules occur; (3) a narrow space, the "breathing-chamber" of Newport*, separating the vitellus from the external capsule, and permitting it to revolve freely within the latter; lastly, the ovum possesses (4) an external protective membrane, the yolk-sac of Ransom †. It is structureless, tough, hyaline, destitute of pores or striations, slightly resilient, and varies in thickness in different species, though always comparatively thin and of great transparency. It is of uniform thickness in the same ovum, being most tenuous in *P. limanda*, measuring not more than ·0001 inch in thickness. It is slightly denser in *P. flesus*, ·000127 inch; in *Gadus morrhua* it measures ·00025; but it is considerably thicker in the ovum of *T. gurnardus*, being no less than ·0005 inch. One aperture pierces the capsule, and its structure is the same in the several species, exhibiting an "hour-glass" form, with a crater-like external and a larger internal opening.

Deposition.

As the ova mature they pass posteriorly, and descending to the genital aperture are readily expelled. Differences in the manner and duration of spawning doubtless obtain, as already stated, in the various species of food-fishes; but the ovarian walls, assisted by the abdominal parietes, at this time much distended, probably in all cases effect the extrusion of the ova. Very slight pressure upon the abdomen of a well-developed female causes the eggs to issue in a continuous stream, and artificial spawning may be easily performed. Amongst the Pleuronectidæ cases frequently occur of egg-bound females, in which the contained ova are translucent and mature, but, from difficulty in expulsion, are retained beyond the proper time. Such ova, when artificially extruded and fertilized, may develop in due course, though others under observation did not survive. A lubricating fluid facilitates expulsion; but it possesses little adhesive property, and is not hardened by contact with sea-water, unlike demersal or non-pelagic ova, which are often firmly bound together by this means. It is an interesting fact that the undetermined ova studied by Häckel and E. van Beneden ‡, though pelagic, adhered together in masses, and that the ova of *Lophius piscatorius* float in masses of mucus. Upon expulsion the buoyancy of these pelagic ova is at once apparent. Though unfertilized they rise to the surface, as Prof. M'Intosh and

* Phil. Trans. vol. cxli. 1851. † Ibid. vol. clvii. p. 433.
‡ Quart. Journ. Micr. Sci. vol. xviii. 1878, p. 42.

Dr. Hensen noted *, and congregate in scattered groups like oleaginous globules, but show no tendency to adhere together. They float freely and are carried about by the slightest current in the surrounding water. In still water they often congregate in masses and form layers, the uppermost stratum being pushed to the surface by the buoyancy of those underneath. Usually, however, they occur sparsely scattered over large spaces, and in the open sea, except in certain areas, they are so widely dispersed as to be rarely procured. Their buoyancy Dr. Wallem considers to be favourable to their development; and, in reference to the cod, when the eggs, from the more exposed Norwegian spawning-grounds, are (he says †) "carried away by currents to a calm and secure place on the lee-side they will be hatched under favourable circumstances, and the fry will find an abundance of hiding-places and food along the coast."

Fertilization.

Pelagic ova float near the surface of the water for some hours; but their buoyancy is affected by various conditions, especially adulteration of the sea-water surrounding them ‡. If no spermatozoa come into contact with them, in from two to eight hours, their translucency becomes impaired, and decending to the bottom they assume a milky opacity, the capsule becoming wrinkled and distorted. This is probably the fate of vast numbers of pelagic ova in our seas; and Hensen §, indeed, found in the inner bay of Kiel quantities of non-living ova of plaice and cod while dredging in 1881. Unfertilized eggs of *T. gurnardus* occasionally assume a bright pink colour, the cause of which has not been satisfactorily determined. The minute vesicles and granules suspended in the protoplasmic investment of the yolk persist for thirty or forty minutes after fecundation and then slowly become less abundant. The entrance of the spermatozoon was never actually seen, although successive series of ova were prepared and carefully watched in the laboratory, and active spermatozoa were seen clinging to the external capsule; but it is probable that each ovum admits only one spermatozoon through the micropyle. The fertilized ovum is readily distinguished from those in an unimpregnated condition by its more trans-

* U. S. Fish. Comm. Report, 1882, p. 434; see also Report of Royal Comm. on Trawling, 1884, p. 36.

† Int. Fish. Exh. Lond. Conference Papers: 'Fish Supply of Norway,' F. M. Wallem, p. 9.

‡ *Vide* 'Report of H.M. Trawling Commission, 1884,' p. 362, and 'Second Annual Report of Fishery Board for Scotland,' App. F, p. 47.

§ U. S. Fish. Comm. Rep. 1882, p. 434.

lucent and tense appearance. Several large enucleate cells often occur near the centre of the yolk at this early stage, but their significance and fate are not known.

Formation of the Blastodisc.

At the lower pole of the yolk-globe the film of pale ochre-tinted protoplasm increases in thickness, and the entire surface of the vitellus appears corrugated. These ridges are, however, very faintly indicated, and they mark meridional areas of transference, along which much of the cortical protoplasm passes to the germinal pole.

Segregation of protoplasm probably continues during the whole process of cleavage; but it is most apparent during the first hour after fertilization, when the disc is being formed, as a plano-convex cap of a faint straw-tint, in which granules sparsely occur and one or more larger vesicles appear. The disc increases not only by peripheral, but also by subgerminal transference, as is shown by the fact that vesicles and granules may be distinguished, situated partly in the disc and partly in the underlying matrix. Viewed from above, the disc is almost perfectly circular, and has the form of an inverted *plaque* depending from the yolk, the food-yolk being thus uppermost, in contrast with the Amphibian ovum, in which the animal pole is uppermost and the large food-yolk cells occupy the lower pole. The vitellus, with its germinal pellicle, revolves freely within the capsule, and the embryonic area can thus maintain its ventral position when the ovum is turned over.

Segmentation.

A central cavity soon appears below the blastodisc, by which it is lifted away from the yolk, except at the periphery, where the continuity of the disc and the periblast is never broken. This dehiscence was noted in *T. gurnardus* while the first cleavage was in progress, and in other Teleosteans a similar cavity has been noticed at an early stage; but it is not usually regarded as representing the true segmentation cavity, the latter being recognized only when the later multicelled stage is reached. The first cleavage is incomplete, *i. e.* the disc is not sharply separated from the periblast, and the two blastomeres are confluent below. The second cleavage cuts the first furrow at right angles, and four blastomeres result. Asymmetry is very frequent at the first cleavage, and the two cells show great disparity in size. Doubtless the phenomenon is due chiefly to unequal transference of the diffused protoplasm of the yolk; but the form and size of the cells are

altered by an inherent power of movement which the constituent protoplasm possesses. To this movement are due the creases and furrows continually diversifying the surface of the blastomeres during cleavage, as well as the retrogressive process by which blastomeres reunite occasionally after cleavage. Irregularities in segmentation are far from unfrequent*, fourteen or eighteen cells being produced, and the outline of the segmenting blastodisc is thus varied, though the circular contour is always restored when the multicelled stage is reached. The blastomeres thus do not always increase with that serial regularity of geometrical progression which typical segmentation illustrates. Cleavage in a plane parallel to the upper surface of the disc commences when the blastoderm is multicelled, *i. e.* consists of from fifty to eighty blastomeres, and the form of each cell is altered by the increased pressure of adjacent cells; the original rounded or amorphous outline being lost it becomes polygonal. The constituent cells simply consist of naked protoplasm, and at the same stage vary very much in dimensions, exhibiting a large, clear, more or less central nucleus, which is not, however, always distinguishable; indeed there is evidence to show that periods when the nuclei of the blastoderm and periblast are visible alternate with periods when the nuclei are diaphanous. A similar rhythmical alternation may be observed in the process of cleavage, a discontinuity marked by alternations of activity and quiescence.

Segmentation is not confined to the limits of the disc, but at the margin the protoplasm of the periblast forms elevations between which the lines of cleavage extend, and cells are thus outlined in the investment of the yolk, which without doubt must be added to the blastodermic mass.

The Periblast.

Cells formed, as just described, beyond the margin of the disc contribute to the increase of the embryonic area; but such periblastic additions to the blastoderm appear to be very limited, and it is rather by an imperceptible process of intussusception that its increase must be accomplished and the decrease of the vitellus accounted for. The lines of cleavage cannot be traced far over the surface of the periblast; they are most distinct in proximity to the periphery of the disc, and more remotely they pass insensibly away. The nuclei of the periblast, which are more or less oval and well defined

* At St. Andrews irregularity was most frequent in the ova of *T. gurnardus*; but Ryder noted the same feature in the cod (U. S. Fish. Comm. Rep. 1882, pp. 486–7, pl. ii. fig. 12).

and possess a nucleolus, appear at first close to the margin of the disc and are crowded together, but soon are distributed over a wide though variable area called the "nuclear zone." The origin of these nuclei is still undecided, and as they appear primarily quite at the periphery of the blastoderm, and increase row by row over the periblast-stratum, they have been derived by some authors from the nuclei of the disc. Not only do they extend outwards, but, as Agassiz and Whitman noted, they extend inward beneath the disc, and are prominently seen studding the floor of the segmentation cavity. They are often more numerous in some parts of the periblast, and less numerous or wholly absent in others.

Invagination of the Rim.

Towards the close of the first or on the second day the blastodermic rim appears. Its mode of origin is uncertain, though appearances in the living ovum strongly suggest its growth as a true invaginated layer, separated from the cells of the disc above by a distinct fissure which cannot be traced to the periphery.

Henneguy * holds that the rim is really inflected, but that the outermost or "corneous epiblast" layer takes no part in the process, an opinion which is directly opposed by Kingsley and Conn. Certainly Œllacher's view (with which Ryder agrees), that the hypoblast arises *in situ* by a simple differentiation of cells, presents this formidable difficulty, that a great part of the floor of the segmentation cavity is permanently periblastic, and that the rim merely interposes between the disc and the periblast beneath the embryonic radius and in proximity to the margin. Further, the rim clearly proceeds from the periphery towards the centre, beneath the disc, and this is inexplicable if the process be one of delamination. Nor do appearances strongly favour the theory that the rim is solely derived from the periblast; but as periblast cells are undoubtedly added to the periphery of the disc, the rim is probably a derivative from both.

In *Petromyzon* the epiblast layer extends by marginal addition, by the conversion, in fact, of the non-embryonic yolk-cells into epiblast cells †; and by a like process, doubtless, epiblast and lower-layer cells in Teleosteans increase at the margin, the converted periblast cells being immediately reflected, along with archiblast cells, to contribute to the growing and extending blastoderm. With the invagination of the

* Bull. Soc. Philom de Paris, Apr. 1880

† A. E. Shipley, "Mesoblast of Lamprey," &c., Proc. Roy. Soc., Nov. 1885.

rim, whose growing (inner) margin is, at first, parallel to the circumference of the disc, the latter by epibolic extension thins out, and presents in optical section a crescentiform outline. At one point, however, by a proliferation of epiblast cells, a thickening is produced coincident with one of the radii of the disc.

Formation of the Embryo.

The thickened portion of the rim, just mentioned, shows from the first a central enlargement, indicating the future head of the embryo, and an alar expansion upon each side produces a broad scutiform outline. The apex of this scutum becomes the permanent cephalic extremity, and prominently projects as a protruding carina upon the sub-blastodermic matrix, whilst posteriorly the tapering trunk of the embryo is gradually defined. The greater part of this embryonic thickening is made up of epiblast cells, which constitute the axial (neural) cord. This cord grows downward and divides the undifferentiated "lower layer" cells into two lateral cuneate masses, out of which the muscle-plates are built. The dorsum of the embryo is superficially rounded and projecting, showing no trace whatever of a longitudinal medullary groove, and there is no ingrowth of the corneous layer, such as Calberla describes in *Syngnathus*, the neurochord arising as a solid rod in which for some time no neural canal develops. It is interesting to note that *Petromyzon* precisely agrees with the Teleosteans in this feature, and, in both, the medullary canal arises as a fissure, which appears at first in the thickened anterior portion and extends posteriorly, the process being simply one of dehiscence, the central cells separating to form a longitudinal vertical fissure *. The epidermic layer now separates from the neurochord, and the hypoblast becomes thickened along the ventral median line and presses upward against the ridge of the neurochord, which is thus somewhat flattened on its under surface. The central rod of hypoblast, thus differentiated and detached, is the notochord, and posteriorly it is insensibly lost in a caudal mass of indifferent cells. At an early stage, before the notochord is completely established, its cells are in close apposition to the mesoblast cells upon each side, and the two masses can with difficulty be distinguished from each other. This difficulty of clearly distinguishing the cells of the different layers is one common to all the early stages of Teleostean development.

Meanwhile the blastoderm is proceeding epibolically to

* Shipley, "Nervous System of *Petromyzon*," Cambr. Philos. Soc. March 1886; and Scott, Quart. Journ. Micr. Sci. vol. xxi. p. 145.

invest the yolk, and on the second day usually covers more than a third of its surface. Early on the third day the equator is passed, and at the fifty-fourth or sixtieth hour the blastoderm generally envelops two thirds of the yolk. The cephalic end of the embryo remains stationary in the forms under consideration; but as the caudal extremity keeps pace with the advancing periphery of the blastoderm, its increase in length must take place in the region of the trunk. The blastopore reaches its maximum at the equator of the ovum, and when that is passed its circumference continuously decreases. The rim does not increase appreciably in density or breadth, but, on the contrary, its substance diminishes, and this must be so if, as it progresses, it contributes to the investment of the yolk. When the blastopore has so far decreased as to appear merely as a minute aperture (on the fifth or sixth day) at the posterior extremity of the embryo, the rim is recognizable only as an aggregation of cells—the cells of the coalesced margin. This remnant is probably used in the formation of the anal section of the mesenteron and other structures; but it does not appear that the caudal plate is formed directly and almost solely, as Ryder maintains, out of these cells, the tail, like the rest of the trunk, increasing in length by the addition of mesoblast somites. Still more questionable is the theory of Rauber and His, adopted by Ryder, that the hind portion of the embryonic trunk exemplifies the phenomenon of concrescence, since it is not supported by study of the living embryo, and sections reveal no trace of a median fissure or line of apposition continuous with the longitudinal vertical plane of the anterior region. Indeed the caudal plane of symmetry is at right angles to the plane of symmetry in the rest of the trunk, for the tail lies sidewise upon the yolk, and apparently develops and continues in a state of torsion until the embryo is free. Further, the solid condition of this portion of the embryo is maintained till a comparatively late stage, when the medullary canal finally penetrates it, as the first median fissure which divides its cells.

The complete differentiation of the notochord coincides in many species with the closure of the blastopore. This is the case with *Gadus merlangus*, *G. morrhua*, *P. limanda*, and *P. flesus*; but in the case of *G. æglefinus* and *T. gurnardus* the closure of the blastopore is one or two days later.

Nothing noteworthy was observed respecting Kupfer's vesicle; it has the same structure in the various species, though in *T. gurnardus* (in which it was not observed until twenty-four hours or more after the blastopore had closed) it

is often compound, and presents the appearance of a group of bubble-like structures enveloped by a thin protoplasmic stratum undistinguishable from the protoplasm of the underlying periblast. In some Teleosteans it can be made out very early; according to Henneguy it appears in *Salmo fario* at the time when the blastopore coincides with the equator of the vitellus; but usually its appearance immediately precedes or succeeds the closure of the blastopore.

Sense-organs, Heart, Cœloma, Wolffian Ducts, &c.

In the evolution of the sense-organs few special features can in this place be noted. The optic vesicles are always rapidly budded off when the cephalic enlargement of the neurochord is defined. They are solid and somewhat ovoid, and their cells soon show a radial disposition, as though about to dehisce along a central vertical plane in order to form a median chamber, longitudinally placed. The formation of this chamber—the cavity of the primitive vesicle—is never accomplished, and only when the ingrowth of epiblast and the formation of the concentrically laminated lens pushes the external portion inward upon the inner portion of the *bulbus oculi* is a cavity formed within the vesicle, the so-called secondary vesicle. By this involution of superficial epiblast the rim of the secondary cup is left imperfect upon its ventral margin, and this breach is the choroidal fissure. The olfactory diverticula are pushed out as modifications of the brain a little later, and on reaching the epiblast in front of the head a ganglion is formed, uniting with an epiblast thickening, from which the olfactory nerve, according to Beard*, is split off, and thus, like the cranial nerves, is partly epidermal.

Like the eye, the ear in the Teleostei originates as a solid differentiation of cells. The otocysts can be distinguished twenty or thirty hours after the blastopore has closed. They are ovate in form, and rapidly develop a lumen, which is at first a narrow fissure surrounded by dense epiblast. The lumen rapidly enlarges, the walls become thinner, and before the embryo emerges from the ovum each otocyst develops two calcareous refringent otoliths, which exhibit a marked radiate structure.

The heart is a prominent structure in the early embryo and protrudes as a solid mass of splanchnic-mesoblast cells in the centre of the pectoral region, antero-ventrally situated below the otocysts. For some time it is solid and function-

* Beard, "Branchial Sense-Organs of the Ichthyopsida," Quart Journ. Micr. Sci, Dec. 1885.

less; but the appearance of a central lumen is accompanied by faint irregular pulsations. It is a simple tubular structure, and its cellular transparent walls assume a rugous appearance. Though no hæmal fluid can be detected until some days after emergence, the cardiac contractions were first noted on the following days:—*G. morrhua*, sixth day; *G. merlangus*, eighth day; *P. limanda*, tenth day; *G. æglefinus*, eleventh day; and *T. gurnardus* on the fourteenth day. The rhythmic movements when commencing are very slow; but when they become regular they average from twenty to thirty pulsations per minute, and when the heart is in full vigour the rate increases to forty-five beats per minute, while the embryo is still within the ovum.

As early as the fourth or fifth day a primitive cœlomic cavity develops as a horizontal fissure traversing each of the lateral muscle-plates and dividing the somatopleuric from the splanchnopleuric portions. In the proximal niche of the cavity thus formed upon each side of the embryonic axis a special part is differentiated which performs the function of an excretory duct *. At a very early stage these longitudinal tubes, whose walls consist of a single layer of cubical epithelial cells, can be traced along the line where the somatopleure and splanchnopleure remain continuous, each terminating anteriorly in a crozier-shaped loop with an infundibular opening, near which is a plicated body enclosed in a capsule, apparently a single glomerulus. Shifting their position, these tubes, the Wolffian ducts, lie on the ventral side of, and pass parallel to, the *vena vertebralis*, and posteriorly they unite to form a large urinary vesicle immediately below the origin of the tail, prominently seen in the newly-emerged embryo.

Notochord and Vertebral Arches.

The notochord arises as a rod of small cells almost undistinguishable from the neurochordal and mesoblast cells; but transverse cavities soon appear, produced by the breaking up of the original cells, which again give place to more spacious chambers filled with juicy protoplasm, much vacuolated, and forming a reticulated meshwork of great complexity. Though flexible, the notochord possesses some rigidity, due to the pressure of the protoplasmic contents of the metamorphosed cells and the continuity of their membranous walls. From the outermost cells a cuticular sheath is formed, but it is thin and shows little lamination. Outside the chordal sheath a

* *Vide* Sedgwick, "Development of the Kidney," Quart. Journ. Micr. Sci. vol. xxiv. p. 64.

mesoblastic perichordal investment is developed from the innermost cells of the protovertebræ. This is the reduced representative of the thick skeletogenous tube of Selachians and Ganoids, and probably consists of a *membrana elastica interna* only, though in favourable sections of young Teleosteans two portions can be distinguished, a *membrana limitans externa*, which passes dorsally to enclose the neurochord (constituting Rathke's *membrana reuniens superior*) and sends fibres down to meet below as the *membrana reuniens inferior*. It may be doubted whether the *elastica externa*, which separates the inner from the outer half of the skeletogenous layer in more primitive fishes, exists at all in Teleosteans, though in *Mustelus*, the Rays, etc. this layer is much nearer the chorda than in the *Holocephali*, *Notidanus*, etc., in which forms it is separated by a considerable interval from the *elastica interna*. The outer layer, which we have distinguished as a *limitans externa*, may in reality be homologous with the *membrana elastica externa*, and certainly in the species here considered cartilage develops, and McMurrich observed * in *Syngnathus* a deposition of ossific matter in this external layer. As the nucleated cartilage cells arise they proceed outwards from the perichordal sheath as two superior and two inferior rami (to each developing vertebral body), forming the neural and hæmal arches respectively.

Cartilage appears to develop independently above the medulla (in the *membrana reuniens superior*), and the hæmapophyses never really meet in the middle line, just as in the cartilaginous sturgeons, but coalesce with the median dorsal cartilage, which occupies the position of the longitudinal elastic band between the distal ends of the upper rami, in *Acipenser*, for example.

Branchial Arches.

The branchial arches are indicated as ridges passing dorso-ventrally in the œsophageal region some hours before hatching. They certainly remain closed for several days after their appearance, and the clefts are not open to the exterior until the cartilaginous bars are developed. These bars can be detected in course of development soon after the embryo has emerged, the first arch developing so rapidly as to distort the outline of the head. An anterior process (the maxillary) passes immediately beneath the eyes; but the hyoid arch, being nearer the middle line, is less readily made out in the

* Quart. Journ. Micr. Sci. 1883, p. 647.

living embryo, though by the fifth or sixth day after emergence it is very movable and is raised and depressed constantly, even before the oral aperture exists. Behind the second arch the four successive branchial arches are seen as stout cartilaginous rods developed in the anterior margin of each cleft. By a forward movement of the lower curved rami of these arches they become approximated, so that a transverse section, if very slightly oblique, may pass through the series with the exception of the first arch.

Fins.

At a very early stage a fold of epiblast in the post-otocystic region is the commencement of the pectoral fin. This thickened fold upon each side assumes a rude oval outline and lies in a horizontal plane upon the yolk. The proximal portion becomes narrowed and much denser, due to the median intrusion of mesoblast tissue, which pushes its way between the upper and lower epiblast cells of the fin-fold, and, ceasing before reaching the limits of the fin, gives the margin a more transparent appearance. When the embryo emerges, the fin is a stout fan-like structure and has shifted slightly from the original horizontal plane. The basal thickening still continues, and the mesoblast cells contributing to it show a tendency to assume a radial arrangement, these radial lines extending also into the thin distal border, while at the centre of the peduncle cartilage develops independently, and extends distally as a thin central plate, unconnected at the base with any pectoral arch rudiment. Whether this central cartilage develops into the *ossa basalia*, the sole remnant of the primitive fin of fishes, or breaks up into radial rods, was not made out.

Cranium.

Simultaneously the first skeletal elements of the cranium, until now a mere fibro-membranous investment of the brain, appear as two cartilaginous bars, the trabeculæ, interesting as showing at once longitudinal bifidity in the embryo. In the interspace between them the hypophysis passes down to meet the pituitary diverticulum. The roof of the oral aperture is pushed up, not only at the point where the infundibulum is formed, but along the middle line anteriorly, this median involution giving the mouth in cross section a deeply-grooved character, with a flattened base or floor. At the oral end of the notochord and along each side two dense plates of cartilage arise—the parachordals—which grow rapidly and form

the thick basilar plate. This plate unites with the trabeculæ in front, and the floor of the cranium is thus completed, while the walls and roof are still membranous. The notochord, on penetrating the skull, bends down very suddenly at an angle of about 90°, and the basilar plate bends down likewise, but passes forward at a more moderate angle—this declination of the spheno-occipital plate or basilar cartilage producing a flexure of the cranial region, which is much greater than usually supposed; indeed, the floor of the skull, soon after the embryo emerges from the ovum, lies in a plane almost parallel to the plane of the branchial arches.

Stomodæum and Proctodæum.

The preceding skeletal structures are usually well developed within a week or ten days after hatching; but it is not until that time is completed (the seventh day or later) that the stomodæum is externally open. The anus is still later. Nor is this surprising, as the embryo derives all the needful nutriment from the store of yolk which protrudes so prominently on the ventral aspect of the body during these early stages. Its bulk, however, continuously diminishes, and soon after the anal aperture arises it wholly disappears. The anus in all the forms under consideration appears comparatively late.

The anal tract is thus a solid cord until the lumen of the mid-gut extends into it, the communication of the proctodæum and the anterior portion of the alimentary canal being apparently incomplete until the tenth or fourteenth day after liberation.

Hæmal System.

The vascular system cannot be treated in detail in this place; but one point demands some reference. As already stated, the heart's pulsations commence at an early embryonic stage, long before a true hæmal circulation exists. It can hardly be doubted that a colourless plasma is distributed over the trunk of the embryo, though it is impossible to detect any such lymph-circulation. At a certain late stage red corpuscles do make their appearance, though whence they are derived is a question as yet undecided. Many considerations favour Ryder's view that they are directly periblastic, and some evidence, from observations on *Alosa* *, *Salmo*, and *Gastrosteus*, seems to support it. Sections of early embryos

* In the embryos of this species Ryder affirms that the venous end of the heart opens into the persistent segmentation cavity (U. S. Fish. Comm. Rep. 1882, p. 537).

in which the subnotochordal trunks are developed show an abundance of nucleated cells, of large size and spherical form (becoming polyhedral in microscopic preparations), filling up the lumen of each vessel. Those which crowd the *vena vertebralis* are strongly held by one observer * (K. F. Wenckebach) to be the original form-elements of the blood. Precisely similar cells, rounded, colourless, and nucleated, completely fill up the lumen of the aortic trunk. If Wenckebach be right, his conclusion must be extended, and the undetached cells in the aorta must be also regarded as original blood-cells, which have not yet acquired the colour and other characteristics of blood-corpuscles. In several series of the embryos of *Gastrosteus spinachia* at the St. Andrews Marine Laboratory the passage into the heart of corpuscles, detached from the yolk-cortex or periblast, was observed on many occasions †, and it is highly probable that these are hæmal form-elements; but further observations are needed. No perivitelline circulation, such as is seen in *Gastrosteus*, *Cottus*, *Liparis*, etc., was observed in any of the advanced embryos studied, though a branchial subnotochordal, caudal, and in some cases a cœliac circulation was active. Thus minor differences doubtless obtain in the development of the blood-corpuscles in various Teleosteans.

Diagnostic Features.

(1) *Ova.*—It was pointed out on a preceding page that the ova, as well as the early embryos, of the species under consideration are remarkable for the few external points of difference which they present. Their identification is often a task of considerable difficulty, and even familiarity with the various ova does not entirely remove the uncertainty of determination. Hence the desirability of establishing reliable points of difference. Arranging the ova in the order of size, which is a distinctive character sufficiently well marked to serve for determination in the laboratory, the following features may be noted:—

Pleuronectes platessa: diameter ·065 to ·069 of an inch.—The largest ovum of the various species treated of in this paper. Form spherical, hyaline capsule denser than in the two species of *Pleuronectes* mentioned below. The embryo shows pigment at an early stage of a pale yellow tint, quite distinguishable from *P. flesus*.

* Journ. of Anat. and Physiol. vol. xix., April 1885, p. 231: Wenckebach, "Development of Blood-corpuscles" (*Perca*).

† Ann. & Mag. Nat. Hist., Dec. 1885, p. 494; and U. S. Fish. Comm. Rep. 1882, p. 548.

Trigla gurnardus: diameter ·0598 of an inch.—Spherical form almost constant, spheroidal ova being rare; capsule hyaline and dense; vitellus exhibits a large, pale salmon-tinted oil-globule. During development several large cells (multinucleate) occur in proximity to the embryo, and stellate nucleated particles of protoplasm soon after closure of the blastopore occur, distributed over the surface of the vitellus.

Gadus æglefinus: diameter ·058 in.—Ellipsoidal form frequent; capsule thin and of great translucency; no oil-globules.

Gadus morrhua: diameter ·0551 in.—Ellipsoidal form sometimes preponderates; capsule hyaline, but slightly denser than in the other Gadoids enumerated here. Shows a faint bluish translucency. No oil-globules.

Gadus merlangus: diameter ·0476 in.—Very crystalline in its translucency. During development exhibits (about the seventh day) one or more enucleate structures, elaborately stellate, usually occurring one on each side of the embryo near the mid-mesenteric region; sometimes a third, asymmetrically placed, occurs. They have the form characteristic of a "bone corpuscle." No oil-globules.

Pleuronectes flesus: diameter ·038 in.—Usually spherical, but ellipsoidal form is frequent. Capsule hyaline and exceedingly tenuous.

Pleuronectes limanda: diameter ·033 in.—Hensen compares the ova of this species with the preceding (*P. flesus*) in the following terms *:—"Those of the flounder are small; but the smallest of all (less than 1 millimetre) are those of *Platessa limanda*." Capsule hyaline and very thin. The whole ovum exhibits a delicate golden-brown tinge, which is characteristic. On the fifth day after fertilization the vitellus exhibits a remarkable reticulation, apparently due to the peculiar disposition of the protoplasmic yolk-cortex. Polyhedral spaces are enclosed by the intersecting ridges, which appear to be merely superficial and therefore unlike the reticulation which penetrates the entire yolk-mass in Elasmobranchs, forming, as Dr. Schultz discovered, a series of radial lines from the centre to the circumference. Further, according to Balfour† they exist before and after fertilization, whereas in *P. limanda* no reticulation is visible until long after fertilization.

* U. S. Fish. Comm. Rep. 1882, p. 428.

† Journ. Anat. and Physiol. vol. xix. pp. 379 and 541.

(2) *The Embryos.*—There is little doubt that the pigmentation of embryonic Teleosteans is a feature of great diagnostic value. The valuable observations of Agassiz* upon this subject are well known; but with the exception of Professor M'Intosh's contributions on the subject very little has been done. The study of an extended series of embryos alone can establish the validity of pigmentation as a means of identification; but observations at the St. Andrews Laboratory lend considerable countenance to the contention that embryonic coloration is diagnostic.

Pigment appears in *P. flesus* at the earliest stage, and is, as Prof. M'Intosh describes †, "of a peculiar pale olive-brown (brownish yellow by transmitted light)," forming distinct patches on the dorsum and tail, with intervening lines of spots. Pigment of a more distinctive yellow colour—a rich amber shade—appears in *P. limanda.* Its distribution is similar to that in *P. flesus*; but in neither species does it extend over the yolk. Large stellate black pigment spots occur in the more advanced embryos of *P. limanda*, extending over the eyes, otocystic and hepatic regions to the anus, and along the dorsum and upper margin of the caudal trunk. Crescentic yellow pigment patches appear in the caudal membrane.

G. merlangus exhibits no coloration until the eighth day after hatching, when pale yellow amorphous corpuscles appear, chiefly on the dorsal and lateral surfaces; they extend also over the yolk-surface and embryonic fin-membrane. The tint is characteristic—a pale yellow with a distinctive green tinge. In the two remaining Gadoids black pigment alone appears—in *Gadus morrhua* two days before emerging from the ovum, and in *G. æglefinus* on the eleventh day, in a series which emerged on the twentieth day. In both the spots are at first amorphous and confined to the dorsal aspect of the trunk; but they rapidly extend, especially in the ventral or mesenteric region and region of the shoulder, the pectoral fins being also radially pigmented. *T. gurnardus* is scantily pigmented on the eleventh day, the spots being of a pale sea-green hue; but two days later yellow corpuscles are plentiful, and a few are of an ochreous hue. Lastly minute black spots occur. The surface of the yolk becomes rapidly pigmented as well as the protoplasmic investment of the oil-globule. It is well known that monsters frequently occur: but these were rare in the large number of embryos reared at St. Andrews.

* Proc. Amer. Acad. Arts and Sci., June 1878, pp. 1–18.

† 'Second Annual Report of Fishery Board for Scotland,' 1884, Appendix F, p. 47.

One example (*P. limanda*) possessed two heads, one head being normal, while the other was much confused. The bifurcation occurred in the mid-region of the trunk, and it is remarkable that while the alimentary tract was bifid the notochord was not so. An abnormal example of *T. gurnardus* again was malformed in the cephalic region, only one eye being developed and situated on the ventral side of the head. The otocysts were displaced, but the trunk presented no unusual features.

Conditions of Temperature &c.

It is unnecessary to say that temperature has great effect in accelerating or retarding developmental changes. Thus, in the case of *G. morrhua*, the stage figured by Ryder as the thirtieth day was reached at St. Andrews on the twentieth or twenty-first, the acceleration being due to increase of temperature. When, however, the temperature is about 40° F., a rise or fall of three or four degrees appears merely to abbreviate or lengthen development by about ten or twelve hours. The series of ova and embryos dealt with in the preceding pages were not all reared at precisely the same temperature, but by a constant flow of water from the sea outside the laboratory the temperature is kept as low as possible, and rises very gradually as the season advances. Thus from March (early in the month) to midsummer the temperature of the water in the tanks rose from 34° or 35° F. to 49° and, occasionally, 51° F. Of scarcely less moment than temperature are the other conditions, such as chemical purity of the water and freedom from detritus, mud, &c. These conditions are secured at St. Andrews by the proximity of the laboratory to St. Andrews Bay, on the beach of which the buildings stand, while the harbour passes on the north and west sides of the laboratory. Before flowing into the tanks the water pumped from the bay is retained in a spacious supply-tank until its sediment is all deposited. This course is absolutely necessary, as contact with particles of sand, mud, or mucus in the water inevitably proves fatal. Newly-hatched embryos are such delicate organisms that very slight contact with hard substances (such as contact with the side of the tank) is hurtful, while the slightest pressure at once produces opacity in the transparent embryo, premonitory of death. On emerging the young fishes swim in reversed position, yolk upward, and for some time have little power of guiding their course. By rearing them in tanks of large capacity contact with the sides is in a great degree obviated.

In studying the development of the food-fishes this conclusion

is unequivocally arrived at—that the Teleostei embryologically, as also morphologically, are a highly specialized group, and are too far removed from the primitive or protichthyoid type to yield much material for broad generalizations. Attempts in that direction can hardly in any great degree prove fruitful, and must often be misleading. Abbreviation and the intrusion of secondary, and even tertiary, modifications have been so extensive that the conclusions yielded by Teleostean embryology can never have the interest or application which Selachian development possesses. But though the Teleostei, from great specialization, reveal a striking contrast when compared with such a group as the Elasmobranchs, yet investigations into their development, in which our knowledge is so fragmentary, are of great importance from many points of view, and have, it cannot be denied, an eminently practical bearing. The imperfect state of our knowledge regarding the early history and conditions of development of our important food-fishes is happily not likely to exist much longer. That the embryology of these forms is being actively pursued by many investigators is an encouraging and promising sign. Of hardly less importance is the study of those smaller forms upon which the food-fishes are to no small extent dependent for nutriment.

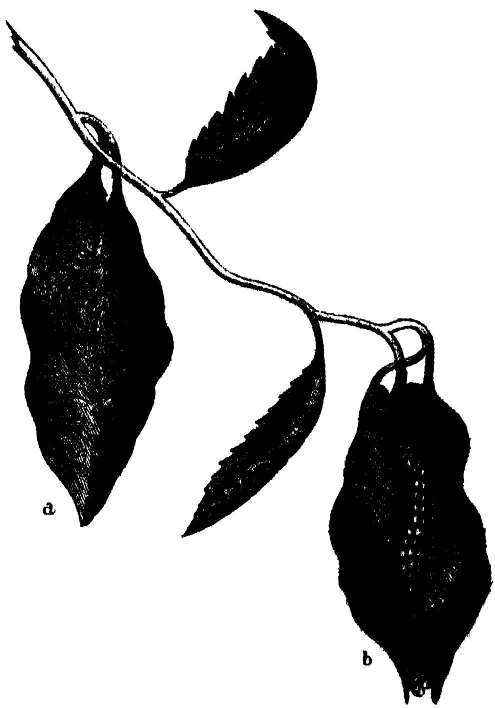
The writer, in conclusion, desires to warmly acknowledge his obligations to Prof. M'Intosh, whose great experience and kind advice are so freely available to those who carry on researches in the Marine Laboratory at St. Andrews. He desires to express his obligations for the use of the scientific section of the University library, for the use of the Caldwell microtome belonging to the University, and for memoirs and accessories in the zoological laboratory at the United College in the University of St. Andrews. Finally, he is under obligations to Prof. Cleland, of Glasgow, and Dr. Hans Gadow, of Cambridge, for suggestions, of which he purposes to avail himself more fully in a later (future) paper, when the preparations, only partially dealt with in this abstract through exigencies of space and time, will be treated more completely.

XLIII.—*On the Oviposition in* Phyllomedusa Iheringii.

By Dr. H. von Ihering, Rio Grande, Brazil.

Until[*] this year, my attempts to discover the mode of reproduction of *Phyllomedusa Iheringii* had failed. I found the frog in numbers during the breeding-season, but could detect no spawn in the water near which they congregated. I have

now been fortunate enough to elucidate this mystery. *Phyllomedusa* does not lay its eggs in the water, although the larva develops in that element, but in the open air, in masses 40–50 millim. long by 15–20 broad, between leaves hanging over the water. Willows are frequently used for that purpose. The egg-mass contains rather large white ova, wrapped up between two or three leaves, in such a way as to be completely enveloped save an inferior opening. My attempts at rearing the eggs failed owing to the leaves drying up; but I am assured that the tailed larvæ may be seen wriggling in the gelatinous mass. As at a later period the latter is found empty, we must infer that the larvæ drop into the water below. The eggs are found only on plants hanging over stagnant



A branch with two egg-masses (*a*, *b*) enveloped in leaves. Natural size.

water. The adult animal is a stupid creature, and will let itself be taken without attempting to escape. Their moderately loud voice resembles somewhat the sound produced by running the finger-nail along a thick hair comb.

Only during the breeding-season (January) do these frogs

make their appearance; at other times not one is to be seen, probably because they establish themselves high up in the trees. Being otherwise engaged, I have not been able this year to follow out the development of *Phyllomedusa*, but hope to do so next season.

This mode of oviposition appears to constitute a passage to that known in *Hylodes*; the development in the latter, however, is entirely atmospheric, and only partly so in *Phyllomedusa*. A similar mode of protecting the earlier stage of life is known to me in a Dipterous insect, probably *Stratiomys*, the egg-masses of which are also attached to leaves overhanging the water; but it is probably as yet unknown among Vertebrates.

Remarks in Connexion with the preceding Note.

By G. A. BOULENGER.

In regard to Dr. v. Ihering's highly interesting communication, I beg to remark that the fact observed is not new among frogs. Another arboreal form *par excellence*, *Chiromantis rufescens*, Gthr. (= *C. guineensis*, Buchh. & Ptrs.), from West Africa, belonging to the family Ranidæ, thus widely remote from the Hyloid genus *Phyllomedusa*, deposits its eggs in a similar way, as we know from a note published by Buchholz. This observer, when collecting in Cameroon, noticed, in the latter part of June, some large snow-white froth-like masses fixed to the leaves of a low tree hanging over a pool. On examination these masses proved to contain freshly hatched frog-larvæ and eggs, which were later identified as those of the above-named *Chiromantis*. He succeeded in rearing the embryos, which developed a powerful tail, external gills, &c., as in the common frog. The froth-like surrounding does not afford nourishment for more than three or four days to the larvæ, which are then dropped into the water, perhaps with the assistance of rain. The egg-mass is sometimes deposited at a height of 10 feet above the water, frequently attached to several leaves stuck together.

I have endeavoured to bring together in a synoptic table the precise facts actually known respecting the mode in which tailless Batrachians deposit or protect their offspring, and I have added a few references for the use of those who may wish for fuller particulars.

I. The ovum is small and the larva leaves it in a comparatively early embryonic condition.

A. The ova are laid in the water.

Probably the majority of Batrachians; all European forms except *Alytes*.

B. The ova are deposited out of the water.

a. In holes on the banks of pools, which become filled with water after heavy rain, thus liberating the larvæ.

Leptodactylus ocellatus, L.; *L. mystacinus*, Burm.; *Paludicola gracilis*, Blgr.*

b. On leaves above the water, the larvæ dropping down when leaving the egg.

Chiromantis rufescens, Gthr.†; *Phyllomedusa Iheringii*, Blgr.

II. The yolk-sac is very large, and the young undergoes the whole or part of the metamorphosis within the egg; at any rate the larva does not assume an independent existence until after the loss of the external gills.

A. The ova are deposited in damp situations or on leaves, and the embryo leaves the egg in the perfect air-breathing form.

Rana opisthodon, Blgr.‡; *Hylodes martinicensis*, D. & B.§

B. The ova are carried by the parent.

a. By the male.

α. Round the legs; the young leaves the egg in the tadpole state.

Alytes ‖.

β. In a gular (the vocal) sac; the young is expelled in the perfect state.

Rhinoderma ¶.

b. By the female.

α. Attached to the belly.

Rhacophorus reticulatus, Gthr.**

β. Attached to the back; the young completes its metamorphosis within the egg.

Pipa ††.

γ. In a dorsal pouch.

aa. The young leaves the pouch in the tadpole state.

Nototrema marsupiatum, D. & B.‡‡

bb. The young leaves the pouch in the perfect state.

Nototrema testudineum, Esp.‡‡; *N. oviferum*, Weinl.§§*

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* Hensel, Arch. f. Naturg. 1867, pp. 124, 129, 138.

† Buchholz, Mon. Berl. Ac. 1875, p. 204, and 1876, p. 714, pl. ii.

‡ Boulenger, Trans. Zool. Soc. xii. 1886, p. 51.

§ Bello y Espinosa, Zool. Gart. 1871, p. 351; Bavay, Ann. Sc. Nat. (5) xvii. 1873, art. 16; Peters and Gundlach, Mon. Berl. Ac. 1876, p. 709.

‖ Demours, Mém. Acad. Sc. Paris, 1741, p. 13; De l'Isle du Dréneuf, Ann. Sc. Nat. (6) iii. 1876, art. 7.

¶ Jimenez de la Espada, An. Soc. Esp. Hist. Nat. i. 1872, p. 139; Spengel, Zeitschr. wiss. Zool. xxix. 1877, p. 495.

** Günther, Ann. & Mag. Nat. Hist. (4) xvii. 1876, p. 379; Ferguson, *op. cit.* xviii. 1876, p. 357.

†† Fermin, Développement parfait du mystère de la génération du fameux Crapaud de Surinam: Maestricht, 1765.

‡‡ Boulenger, Cat. Batr. Ecaud. 1882, p. 417.

§§ Weinland, Arch. f. Anat. Physiol. 1854, p. 449.

BIBLIOGRAPHICAL NOTICE.

British Zoophytes: an Introduction to the Hydroida, Actinozoa, and Polyzoa found in Great Britain, Ireland, and the Channel Islands. By ARTHUR S. PENNINGTON, F.L.S., F.R.M.S. L. Reeve and Co., 1885.

MR. PENNINGTON'S book is mainly a compilation, and does not claim to be anything more. His object has been to supply a manual, moderate in size and therefore in price, which should meet the wants of students up to a certain point and serve as an introduction to more elaborate and costly works. The object is in itself highly useful and commendable, and those who are interested in the diffusion of scientific taste and knowledge will be quite prepared to recognize its value. Such books are clearly required not only for the student at a certain stage of his education, but also for the very considerable and probably increasing class who, without professing to take natural history *au sérieux*, find in it a fascinating pastime. But whilst we fully recognize the value of the work which Mr. Pennington has set himself to accomplish, we feel that a question may fairly be raised as to the conditions under which it is legitimate to appropriate and reproduce the fruit of other men's labours. We do not of course mean to imply that there are "vested rights" in the contributions which the students of science make to the common stock of knowledge. If there were no one would care to enforce them. The aim of all true science is to win more truth for humanity, and the sooner and the more widely it is diffused when it is won the better. But it is one thing to assimilate the results of scientific research and to body them forth with the stamp of our own individuality upon them, and quite another to transfer them without fresh minting and superscription from the pages of their author to our own. Scientific truth, like all other truth, becomes part of the common possession of mankind, and is free to all as the air we breathe; but the literary form in which it is first presented, the dress in which the individuality of its discoverer has clothed it, the colour which it takes from his mental idiosyncrasy—these, it would seem, must be personal property, and are to be respected as such.

We venture to think that Mr. Pennington has transgressed in this matter, and that his manual is too largely made up of material simply borrowed from others, and not assimilated and made his own by any special treatment. The *ipsissima verba* are retained. It is not too much to say that almost the entire framework of the manual is taken, wholly unaltered, from the works of Allman, Hincks, and Gosse. In the case of the Marine Polyzoa, and to a large extent of the Hydroida also, the elaborate diagnosis of the families and genera is copied from Mr. Hincks's "Histories,"—not without acknowledgment, it is true, but, it seems to us, without due regard for the claims of both the author and publisher of these works. We do not wish to press the case against Mr. Pennington; probably he has done nothing which has

not been done by others before him. But a word of caution seems to be needed. We have no doubt that the authors to whom he is so largely indebted are animated by no niggard spirit, and will rejoice that a larger number may participate in the fruit of their labours. We may hope, too, that of those who may be allured by Mr. Pennington's work to the study of natural history, not a few will be led on to the original sources from which he has drawn. None the less, however, is it right that the line should be clearly drawn between the two very distinct kinds of compilation—that which is an exposition of the work of others, informed and vivified by the spirit of the compiler and adapted by him to his special purpose, and that which is in great measure mere wholesale appropriation. The latter, unless it be with the concurrence of the author whose interests are involved, cannot be accounted legitimate.

With this caveat it may be admitted that Mr. Pennington's manual may prove a useful guide to those who desire to collect and study the British species of Cœlenterata and Polyzoa, but are unable to command the large and necessarily costly books to which we have referred. At the same time its value to the student, so far as the Polyzoa are concerned, is considerably reduced by the very imperfect diagnosis given of many of the species. Indeed in a large number of cases there is nothing worthy of the name of a diagnosis, a few particulars loosely and vaguely stated, or a fancied resemblance to some familar object, doing duty for the minute and precise account of the morphological characters which (in this class especially) is essential to sure identification. This may give a more "popular" character to the book, but it must necessarily affect both its scientific value and its practical utility. A great change has passed over the systematic treatment of the Polyzoa within very recent times, and the meagre and indefinite descriptions which the earlier naturalists have left us (with a few illustrious exceptions), and which were still general till within the last few years, are no longer accepted as sufficient. The evolutionary movement has rendered new methods necessary, and as a result we have now much greater precision and fulness in diagnosis, and consequently much more certain identification and much surer data for the study of varietal forms. We should regret to see a return to the old ways even in elementary works. It is only fair to add that, to a large extent, Mr. Pennington must have been hampered by the conditions under which his manual has been prepared. It would have been difficult to do full justice to his subject within the limits prescribed for him.

Objection may fairly be taken to the title of the work, on the ground that it is likely to perpetuate a false idea of the relationship existing between the tribes embraced under it; these, though in part referable to distinct divisions of the animal kingdom and widely different in structure, are blended in a single group under a common name. We cannot admit the force of Mr. Pennington's plea for the course which he has adopted. The fact that some of the Polyzoa "are as much plant-like in appearance as the Hydroids"

is hardly a reason for retaining a term which suggests superficial resemblance only, as if that was the important point; it is rather a reason for discarding it altogether. We believe that it would have been wiser not to sacrifice strict scientific accuracy even for the sake of a convenient and taking title.

A useful feature of the present work, which merits commendation, is the condensed, but carefully compiled, account of the structural plan which characterizes the leading groups. This is quite sufficient for its purpose, without being burdened with detail, and will give the student in each case a clear general conception of the form of life which he is about to investigate. There is also a sketch of the classification, in which due account is taken of the later views. In the case of the Polyzoa the system proposed by Mr. Hincks in his 'History' of the British marine forms is adopted; but it is to be regretted that the author has not explained and emphasized the cardinal principle on which it rests. The only reference to the subject which we have noticed is to be found in the casual remark that "the appearance and arrangement of the zoœcia" are "important elements in classification," which certainly throws no light on the distinction between the new method and the old.

There are special difficulties in the way of framing a natural classification of the Polyzoa, and until very recently systematists contented themselves with one which was admittedly artificial. The suggestive writings of the Swedish zoologist, Prof. Smitt, first indicated the direction in which the basis of a more philosophical system must be sought, and formulated the fruitful principle that it is in the zoœcial characters rather than in the zoarial—in the essential characters of the cell rather than in the mode of aggregation and habit of growth—that we find the surest clue to natural affinity. The scheme of classification elaborated by Mr. Hincks, and to a large extent accepted by recent students of the class, rests on this fundamental principle, which has been confirmed by many new observations, and especially by the evidence obtained of the instability of zoarial habit and the way in which the most marked forms of it are associated indifferently with this or that zoœcial type. Few probably would venture to contend that we have yet reached a complete solution of the problem; but as little can it be questioned that a very considerable advance has been made towards it, and that an immense gain has been realized in the general abandonment of the purely artificial system. In the interest of the student we think that Mr. Pennington would have done well to refer to this very important branch of his subject.

In the account of the species under the several divisions the dryness of mere diagnosis has been relieved by the introduction of many interesting passages from the writings of Ellis, Johnston, Gosse, Landsborough, and others, and the work has thus been rendered more attractive to those for whom it was originally designed—the young student and the amateur naturalist—though not, we fear, without some sacrifice of its value as a scientific guide. The figures by Mrs. Pennington are for the most part sufficiently distinctive and

will be a valuable aid to identification. The concluding chapter deals with the best methods of collecting and preserving specimens, and gives within a small compass a considerable amount of useful practical information. A short "Bibliography" is followed by a "Glossary," in which we note several rather serious errors. The "palpocil" is defined as a "collection of stinging cells;" it is really a simple tactile organ. The name "polypide" is referred to the alimentary zooid of the Hydroida, and "polypite" to that of the Polyzoa; the reverse would be true. "Trophosome" is not (as stated) a "Hydroid colony," but the assemblage of nutritive zooids in such a colony. "Operculum" is defined as a "protective covering or lid," which no doubt it is, as any dictionary would show. But the student wants to know its technical use, and should have been told that it is the valve which closes the orifice (oral valve) of the Polyzoa. The definition of "zooid" as "an alimentary or reproductive polyp" is much too limited. The avicularium and vibraculum are equally zooids. It would have been better to follow Huxley—"a term applied to the individuals of compound organisms."

The peculiar significance of the term "sporosac" is not indicated by calling it a "sac-shaped gonophore." It is, in fact, the generative sac—the sac in which the generative elements are developed.

The publication of the present elementary work may be taken as an indication of a somewhat widely diffused taste for the study of marine zoology, and we trust that it may not only gratify that taste in its own measure and degree, but lead many to desire more than it can give them, and to seek a fuller knowledge of the subject at other sources.

MISCELLANEOUS.

A few Words in Answer to Mr. Distant's "Remarks" on the Genus Terias. By Arthur G. Butler.

Much as I dislike unnecessary discussion on points which do not possess any "scientific value," I must call the attention of lepidopterists to the fact that Mr. Distant, whilst apparently answering my statements, has in almost every case avoided the point at issue, and therefore has laid himself open to the very charge of "misrepresentation" which he asks me to own to; this, *in the interest of science*, it is necessary to prove, since it affects the identification not of what Mr. Distant calls varieties, but of what he, in common with myself, would admit to be representatives of different groups.

Mr. Distant's explanation of his *lapsus calami*, for such I am willing to believe it to have been, is ingenious but not admissible: that he did not carefully consider his words when he called a species (not a "*species*") a variety, I can well understand; but that he, in a certain sense, believed that the said species was more than a variety, is evidenced by the constant use of dubious terms throughout his work, such as "new species or variety," "this species is of a varietal

nature," and so on; however, this matter is unimportant and need not be dwelt upon.

The points respecting *Delias ithiela* and *Terias sari* may be easily settled; the types of both being in the collection of the British Museum, Mr. Distant, who is often able to visit that institution during the year, should neither have trusted my opinion as to the probable locality of the former nor Mr. Moore's identification of the latter. It is no excuse to say, when an error has been committed, "I did but copy the error of my friend;" it certainly reminds one of the ancient inhabitants of Paradise, but not in their happiest condition.

In answering what I thought a sufficiently clear statement respecting *T. senna*, Mr. Distant seems utterly to have missed the point—that the *T. santana* and *T. senna* of Felder are species allied to *T. drona*, or, if he prefers it, are local races of *T. drona,* and have next to nothing in common with *Terias inanata.* My identification of *T. senna* is the same as it always has been, for Mr. Distant himself proves, by reference to my paper of 1871, that I then regarded it as possibly a variety of *T. santana*; he must therefore be mistaken when he says that he examined specimens of *T. inanata* and *T. senna* in the national collection and failed to see any differences, since the most unskilled lepidopterist would see them at a glance.

Lastly, in my note on *T. æsiope* I begin by the distinct statement that "For some years past this species has been entirely misunderstood;" therefore what I or any one else regarded as *T. æsiope* in 1879 is entirely beside the mark as an excuse for figuring the "true *T. æsiope*" under the name of *T. hecabe*. The typical, and therefore "true," *T. æsiope* being a Chinese species and not occurring (so far as is known) in any part of India, the locality "Continental India" is not correct. If my statement on this head was of a misrepresentative character, I regret that it was made; but until I read Mr. Distant's explanation I always supposed that this truly "somewhat wide" one was intended to rank with others separated by the same stop, thus:—"Continental India; N.W. Himalaya; Bombay;" &c. I am not aware that I have anywhere remarked that Mr. Distant has figured as *T. æsiope* a variety of *T. hecabe*; what I have stated is that he has figured the male *T. æsiope* as *T. hecabe*, var. *a*.

The Nerve-terminations in the Pedicellariæ of Echinida, their Sense-organs and Glands. By Dr. Otto Hamann.

Nerve-terminations have not hitherto been described in the pedicellariæ of the Echinida, nor indeed elsewhere in their bodies. The only statement as to a supposed sense-organ has been made by Sladen *, who observed upon the inner surface of the three valves of gemmiform pedicellariæ in *Sphærechinus granularis* cushion-like elevations, which have since been seen also by later observers, such as Kœhler †. The latter observer says:—" It is possible that these

* Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 107 (1880).
† 'Annales du Musée d'Hist. nat. de Marseille,' 1883.

peculiar swellings perform the function of organs of touch; but it is impossible to find any relations between the cells which compose them and nervous elements." I have been able to detect both the nerves and their terminations, and this both by means of serial sections and by observations on the living animal.

The different kinds of pedicellariæ—gemmiform, buccal, tridactyle, and trifoliate—are to be regarded as exquisite sense-organs. But besides this function of sense-organs, they possess the most various other functions, according to their form, size and structure, and their arrangement upon the test, and these may be ascertained by experimental investigations and by careful observation of the mode of life. The investigation of the minute structure must go hand in hand with these.

If we examine the inner surface of the three jaw-pieces of *Strongylocentrotus lividus*, we observe in the base of each jaw-piece a tumuliform convexity, which is covered with rigid setæ. These elevations are sense-organs, which consist chiefly of epithelial sense-cells, as I have already found to be the case and described in Asterida and Holothuriæ. At their free ends these cells bear tactile setæ, while their basal portions are continued into the finest fibrils, which ramify and are connected with the nervous plexus. A branch nerve runs to each tactile elevation, branching off from a larger nerve-stem, which may be traced to the apex of each valve.

I have found the following statements to apply universally to all the various forms of pedicellariæ as regards the ramification and course of the nerves. In the head of each pedicellaria three nerve-stems are distinguishable, running in the interstitia of the three adductors of the valves. Each nerve-stem runs to the apex of the valve in a direct line. Throughout its course branch nerves of various strength are given off on all sides, which pass to the sense-organs, the musculature, and the glandular sacs. In the interstitia of the three muscular bundles (adductors) there issue very fine fibrils intermixed with ganglion-cells, producing a network of nervous threads which enter the musculature.

In *Echinus acutus* there are two tactile elevations (*pedicell. gemmiformes*) on the inside of each valve. One of these is basal, the other is placed just below the hooked calcareous tip. Between these we find a third sense-organ of simple structure, situated about in the centre of the inner surface of the valve. Between these organs sense-cells are scattered through the whole epithelium, as is shown by the nerve-threads passing to them.

In *Strongylocentrotus lividus* there is only one tactile elevation on the inner surface of each valve (*pedicell. gemmiformes*); it is placed basally, while the apex of the valve is covered with sense-cells.

In *Sphærechinus granularis* the sense-organs are limited to three elevations, situated basally on the inner surface, and these again show separate projections upon which tactile setæ arise. These projections are composed of cells, which form an organ reminding one of the gustatory papillæ of the higher animals. These structures are composed of both sense- and supporting cells.

As regards the course of the nerve-stem, the so-called tridactyle

and buccal pedicellariæ show similar characters, but a simpler structure of the sense-organs. The interior epithelium of the valves, which is characterized by an abundance of long cilia, is covered with sense-cells, which, however, do not, as in the above-mentioned cases, collect together to form special sense-organs. While in the *pedicell. gemmiformes* a strong nerve-stem runs to each sense-organ, in these a number of ramifying nerves are present, running to the epithelium. The nerve-stems consist of very fine threads, upon which are seated bipolar and multipolar ganglion-cells. At the bifurcations these are accumulated in great quantities. Even where the nerves consist only of a few fibres, the ganglion-cells may be easily distinguished from the cells of the connective substance, partly by their size and partly by their coloration with the most different fluids. Even the finest nerve-fibres also may be easily recognized among the connective fibres by suitable staining. The latter are stained in a much less degree than the nerve-fibres.

Those pedicellariæ which possess sense-organs, *i. e.* the gemmiform pedicellariæ, are also all furnished with glands, which are seated in the walls of the valves. They discharge their secretion through an aperture situated at the apex of the valve, and indeed above the calcareous hook, or dorsally. The glandular sacs, of which there are one or two in each valve, are of an oval form, and possess a strongly developed musculature, serving for the evacuation of the slimy secretion. The minute structure of the epithelium lining the glandular sacs presents the most various modifications in the different species, but it would be difficult to describe these without figures.

Besides the *pedicell. gemmiformes* I have found glands in pedicellariæ which cannot without difficulty be arranged under any of the above-mentioned four groups, *e. g.* in pedicellariæ situated on the buccal membrane in *Dorocidaris papillata.*

The function of the different pedicellariæ has hitherto been in dispute without the attainment of any agreement, because the presence of sense-organs and glands, and the minute structure in general, has been quite unknown, and only the calcareous pieces have been described. (The only exceptions to this statement are made by Sladen and Föttinger, who detected and described glands in *Sphærechinus granularis.*)

In the first place, the pedicellariæ, whatever their form may be, will function as tactile organs; this is indicated by the numerous nerve-terminations in both the head and the stem.

The smallest forms, such as the *pedicell. trifoliatæ*, undoubtedly cleanse the test from the smallest particles of sand, Protozoa, and foreign bodies in general, whether these are directly upon the surface of the test or upon the spines. They will also have the function which A. Agassiz has claimed for all forms of pedicellariæ.

The larger kinds, such as the tridactyle pedicellariæ, only rarely serve this purpose—primarily they exist for the purpose of keeping off larger living bodies, such as worms &c., and so act as weapons; but (as I conclude from the transversely striated musculature found only in them) they also serve for attachment to foreign bodies during movement, as has already been established by Romanes and Ewart.

The *pedicell. gemmiformes* have the same function, and in grasping they are assisted by the secretion in the glandular sacs of the valves, as experiment shows. In *Echinus microtuberculatus* the gland-bearing pedicellariæ stand chiefly on the dorsal surface and serve, as I have been able to ascertain from many animals kept in the aquarium, to hold fast fronds of seaweeds &c. with which the sea-urchin masks itself both when at rest and when in motion. In this the slimy secretion of its glandular pedicellariæ is of the greatest service.—*Sitzungsberichte der Jenaischen Gesellschaft für Medicin und Naturwissenschaft*, 1886.

Discovery of the Heart in Gamasus.

To the Editors of the 'Annals and Magazine of Natural History.'

GENTLEMEN,—My attention has just been called to a translation in your February number of Prof. C. Claus's paper in the 'Anzeiger' of the Academy of Vienna relative to Herr Willibald Winkler's supposed discovery of the heart in *Gamasus*. If Prof. Claus and Herr Winkler imagine that the latter has observed this organ for the first time they are in error. It was noticed in 1876 by Dr. P. Kramer, then of Schleusingen, who published his remarks on the subject in the Archiv fur Naturg. xlii. Jahrg. 1 Bd. p. 65, as one paragraph of a paper entitled "Zur Naturg. einiger Gattungen aus d. Familie d. Gamasiden." The paragraph is as follows:—

"Das Circulationsorgan. Bei *Gamasus* findet sich endlich im letzten Drittel des Hinterleibes ein lebhaft pulsirendes Herz. Da bei den meisten Arten die verhärtete Rückendecke die Beobachtung der innern Organe unmöglich macht, so eignen sich zur Auffindung des Herzens nur unerwachsene oder eben durch eine Häutung gegangene Thiere, an denen es aber leicht und sicher erkannt werden kann. Seine Bewegungen sind von denen der Excretionsdruse natürlich auf das bestimmteste verschieden, auch entspricht seine Lage ganz dicht unter der Haut der Lage desselben Organs bei andern Gliederthieren."

Dr. Kramer's observation is perfectly well known amongst Acarologists and has been publicly referred to by Dr. Haller, myself, and others in our writings. It will be seen that Dr. Kramer did not describe the valves, and it is perhaps fair to say that in some quarters doubts have been entertained whether the organ really was a heart or whether the movement was not more allied to the strong, presumably peristaltic, movements which may be observed in the cæca of the alimentary canal in young Gamasids. If Herr Winkler's observation of the valves be reliable it will, of course, strongly confirm Dr. Kramer's discovery.

Prof. Claus may possibly not find it so easy to trace the organ in other families of the Acarina, as, judging from his remarks, he may very naturally anticipate; at all events, I am not aware that it has hitherto been traced in any other, although, as above stated, Kramer's observation has been well known for several years.

I am, yours obediently,
ALBERT D. MICHAEL.

Cadogan Mansions, Sloane Square,
April 17, 1886.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

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XLIV.—*Contributions to the Knowledge of the Physiology and Biology of the Protozoa.* By Dr. AUGUST GRUBER*.

Introduction.

In the following pages I propose to publish a series of experiments and observations which may furnish a contribution to the knowledge of the physiology of the Protozoa. The work is not a finished whole, and, above all things, not an exhaustive investigation; it is intended only to assist in furnishing materials for a structure which must still wait many years for its completion. A part of the facts contained in it I have already made public in preliminary communications †, and I repeat these here in a somewhat extended form. Other experiments, on the contrary, have not hitherto been published, and, indeed, have perhaps never previously been made. May both be received with some interest in scientific circles!

On artificial Divisibility and Regeneration in the Protozoa.

Experiments have already been made in former years upon artificial divisibility in the lowest organisms; for example, in

* Translated by W. S. Dallas, F.L.S., from a separate impression of the paper in the 'Berichte der naturforschenden Gesellschaft zu Freiburg i. B.,' Band i. (1886) Heft 2. Communicated by Dr. Wallich.

† "Ueber künstliche Theilung bei Infusorien," in Biologisches Centralblatt, Bd. iv. pp. 717 722, and Bd. v. pp. 137–141.

the last century, upon the great sun-animalcule, *Actinosphærium Eichhornii*, by its discoverer, Eichhorn himself; afterwards, namely in 1862, on the same object, by Häckel; Greeff, in 1867, artificially divided* the *Pelomyxa palustris*, which he described, and Häckel again made the same experiments with his *Myxastrum radians* †. They all succeeded in obtaining fragments capable of living on by the artificial division of these Protozoa. In the same way botanists have separated fragments from plant-cells, and indeed, as we shall have to notice hereafter, from multinucleate cells, and by this means have obtained small living individuals.

In ciliated Infusoria, and therefore in unicellular animals of complicated structure, these experiments were first made very recently, and indeed simultaneously, by M. Nussbaum and myself. Nussbaum, whose observations were published‡ before mine, operated with *Oxytricha*, and showed that if such an Infusorian was divided by a sharp cut longitudinally or transversely into two parts, these were able, within a short time, usually on the following day, to convert themselves again into perfect animals, each half replacing the other deficient one, the anterior end replacing the lost posterior end, and *vice versâ*; smaller fragments also were capable of completing themselves again.

For my part I have made use of another object in my experiments, namely, the large *Stentor cæruleus*, which certainly is not so resistent as *Oxytricha*, and cannot be preserved alive so long isolated; but, on the other hand, from its larger dimensions and its exceedingly characteristic mode of ciliation, allows the course of the regeneration to be more easily and distinctly watched §.

In the first place, as regards small injuries, these heal very rapidly, the cortical layer closing together at once over the wound; when the mutilations are more profound, on the contrary, the Stentors often acquire a crippled form, which is either not lost again or, as I have frequently observed, only disappears quite gradually. Thus a Stentor which had grown deformed in consequence of a cut on one side, and had become drawn out into an abnormal hinder extremity quite close to the peristome, occupied eight days before it had again become quite normal.

* "Ueber *Actinosphærium Eichhornii*, &c.," in Arch. für mikr. Anat. Bd. iii.

† "Monographie der Moneren," Jenaische Zeitschr. für Naturwiss. Bd. iv. (1868).

‡ Sitzungsb. der niederrh. Gesellsch. für Natur- und Heilkunde zu Bonn, Sitzung. der med. Sect. 15 Dec. 1884.

§ As previously stated (see Introduction) I have already made known what follows in shorter communications.

Stentor cœruleus is particularly well suited for the observation of the mode in which injuries to the external surface heal up again, on account of the broad blue stripes of the cortical layer. Thus if we make a short sharp cut in the cortical layer with the scalpel, the animal of course shrinks together and the wound at once closes, but at the same time the stripes and the muscular fibres are still separated by the cut at the place affected and can only gradually grow together again. In a few hours, however, this is also effected, but usually so that a displacement has taken place, the corresponding ends not having found each other, and furcations and bendings of the stripes are produced which always betray the place of the incision. The mobility of the Infusorian is, however, by no means affected by this, and indeed, even in the normal animal, furcations of the stripes and muscular fibres very often occur towards the anterior extremity. The mode in which the extremities of the cut muscular fibres endeavour to find each other and finally grow together again no doubt resembles on a small scale the course of events which we have to imagine in the process of wound-healing in the muscles of higher animals.

As regards the complete division of the Stentors into two or more parts, I have already remarked that this usually leads to the production of the same number of perfect Infusorians as there were pieces, although with a limitation, as will be shown hereafter. With some practice the section itself is easily performed, if a tolerably sharp little scalpel is employed, only it is often difficult to ascertain the right quantity of water; for if the drop on the slide is too large the Infusorian swims away from under the knife, while if it is too small the Stentor becomes too much flattened out and quickly deliquesces after the section is made. I may here mention, however, that the deliquescence may be prevented by quickly adding water, and that Stentors which have already suffered considerable loss of substance may recover and become perfectly regenerated.

If the section has been cleanly made and the quantity of water rightly adjusted, the two wounded surfaces immediately close again, and the two halves swim briskly about; they may be fished out with the pipette and isolated, which is best done in small watch-glasses, and then in the course of from twelve to twenty-four hours the lost parts are completely replaced in each of the pieces. If we employ a lens or a low power of the microscope the sections may be carried in any predetermined direction; and it then appears that the regeneration occurs most rapidly and completely when the section has gone

transversely (fig. 1, p. 493), whilst with sections in the longitudinal line the two halves, which of course are long and narrow, usually become rolled up, and the regenerated parts often appear crippled at first, a peculiarity which, however, as already remarked, usually disappears subsequently. We may therefore say of *Stentor*, as of *Oxytricha*, *that the anterior end replaces the lost posterior end, and the right side the lost left side, and vice versâ.*

The question now is, in what manner does this regeneration take place? and for the settlement of this question *Stentor* is perhaps the best of all Infusoria. Let us first of all consider the anterior part of a Stentor separated by a transverse cut; it is at first broadly truncated at the cut surface (fig. 1), but gradually the body becomes drawn out in length posteriorly, the streaks taper off, and in this way the well-known tapering posterior end is again developed, in which the body-parenchyma protrudes as an apparatus of adhesion. In this mode of regeneration it would almost appear as if no new formation of parts occurred, but rather only a change of position of those already present. Of course the process of regeneration is much more complicated in those specimens of which the anterior end has been cut away transversely. In these also we have at first a straight line or flat surface at the point of section: in time, however, the body of the fragment becomes rounded off at its anterior end until it has again acquired a clavate form; but it is still destitute of any of the large cilia, as indeed the whole peristomial area, with the mouth and the spiral of cilia, has been removed. The reproduction of these lost organula actually takes place *in exactly the same way as in spontaneous division.* The latter process, as is well known, commences by the formation in the median line of the dividing Stentor of a vertically placed stria of large peristomial cilia (membranellæ), and as the process goes on the more does this line of cilia grow, gradually bending into an arc, until finally it forms a circlet of cilia, which constricts off the so-called peristomial area from the rest of the body. At the same time one end (the right) of the stria sinks spirally into the interior of the body, and thus forms the mouth and the œsophageal funnel. In the "decapitated" Stentor also the new peristomial cilia make their appearance on one side, arranged in a vertical line (fig. 2), which then during the further growth surrounds the anterior extremity and originates the peristomial area and the mouth. Here, therefore, we have the interesting fact *that the regeneration of the organula in the Infusoria follows the same course as their new-formation in spontaneous fission.* The to us unknown impulse which

induces the animals to divide, and the irritation caused by the violent removal of a part of the body, are identical in their effects. In the regeneration of the lost organs and portions of tissue in the higher animals we have essentially the same phenomenon, only with this difference, that in the latter the cells perform what in the Infusoria is performed by the elementary particles, micellæ, or what we choose to call them. If we ascribe regeneration in the Metazoa to the influence of embryonally formed cells, *we must here award the function of new-formative elements to originally-formed micellæ,* which, as we shall see hereafter, are subject to the directing influence of the nucleus.

I believe that I can show in the case of *Stentor* that the process of regeneration is a regular one and homologous with the well-known process of new-formation in spontaneous fission. We might conceive that in every Infusorian at a certain time the materials for the organs of a new animal are prepared and stored up in the interior, and at the given moment begin to group themselves; in the artificial division of an Infusorian in this stage, and therefore ready for spontaneous division, a process, which would have occurred at this moment as the new formation preceding spontaneous reproduction, would appear to us to be regeneration. But this is not the case; for, in the first place, it is very improbable that all the Stentors employed in the experiments were precisely in the same stage of development; and, in the second place, I have often divided such as had just been produced by spontaneous fission, or were still engaged in that operation, and these have also become regenerated, which would not have been possible upon the above hypothesis, as the reserve-material in them would just have been used up. *Regeneration, therefore, can be due only to a conversion of elementary parts already present, taking place rapidly upon external irritation.*

As regards the *degree of the regenerative faculty, this is very high in* Stentor; *and no particular part of the body appears to be specially disposed thereto, but all parts of the body react in the same way.*

This is clear from the following experiments:—

If we cut away the extremity of a Stentor far behind the middle of the body, this extremity has the same regenerative faculty as one the cut surface of which was near the anterior end; or, further, if we divide a Stentor first of all by a longitudinal incision into right and left halves, and divide each of these two pieces again into an anterior and a posterior portion, or, which answers still better, make the transverse section first and the longitudinal ones afterwards (fig. 3), all the four

divisions, although derived from quite different parts of the body, are equally able to become developed into perfect animals. There is, however, a difference in the mode of regeneration of such different fragments, because in those quadrants (if I may use the expression) which have retained a portion of the peristomial circlet of cilia, the deficiencies are made up by simple growth, whilst in the parts which show no peristomial cilia the latter must be formed anew in the way above described. There is also no more difficulty in dividing a Stentor into three pieces in such a manner as to obtain the anterior and posterior ends and a median section isolated from each other (fig. 4); this last is likewise able to become perfectly regenerated in the same time as the other fragments, although it has to form anew both the anterior and the posterior extremities.

Although these experiments distinctly prove the high regenerative faculty of the Stentors, the following one does this still more clearly:—A *Stentor cœruleus*, which I will indicate as A, was divided transversely into two halves; next day these had grown into two perfect animals B and B′; the anterior end was now separated from B, and B′ was again divided transversely, when it appeared, after the lapse of twenty-four hours, that B had again regenerated itself, and that the two halves of B′ had become developed into two perfect Infusoria, C and C′. B was again divided, but without result, as on the next day it had perished; while of the two divisional pairs into which I had again divided C and C′, only one derived from C had perished, and the two halves of C′ had again become regenerated into two small Stentors, D and D′; and, finally, I succeeded in obtaining artificially from D and D′ a generation E; but these individuals had now become so small that they had lost their vitality and soon perished. I had therefore succeeded in carrying out artificial division on the same objects for five consecutive days in which regeneration of the lost parts took place five times.

Nussbaum has also demonstrated that artificially multiplied Infusoria, under favourable conditions, are afterwards able to divide further spontaneously, and I have observed the same thing in my experiments. Thus, for example, on the 10th December I had transversely divided nine Stentors and only isolated the hinder extremities; on the next day all the nine had developed new, perfect peristomial areas with the ciliary circlet and mouth; on the 13th December one of these regenerated animals showed the commencement of spontaneous fission, and on the 15th the nine specimens had become fifteen, which I kept alive until the end of the month.

Another experiment is as follows:—A Stentor was, on the 28th April, divided transversely into two halves, both of which had become regenerated on the following day; on the 30th the two artificially produced daughter-individuals had, almost simultaneously, divided again spontaneously. In two other artificially separated divisions also, one of which had been at first deformed, natural fission occurred simultaneously, as also in a third experiment. We thus learn from observation the interesting fact that *two artificially produced halves are able to increase spontaneously at exactly the same time*, although after section they were apparently not equivalent, and the anterior portion, which still possessed the most complicated part of the body, the peristomial area with the mouth and œsophagus, really had only to go through the process of wound-healing, while the posterior portion must have produced all the above organs anew. Nevertheless it was able to answer to the impulse leading to fission just as quickly as the other. This also is a proof *that the material for new-formations in the Infusoria is not stored up predisposed as such, but that the elementary parts above indicated as primitive in the protoplasm are convertible at any time.* That the impulse to fission, which, as will be shown hereafter, we must seek in the nucleus, occurred simultaneously in the two separated portions cannot surprise us if we consider that the nuclear constituents present in them were in connexion only a little while before, and therefore must have agreed in their constitution and in their action upon the protoplasm.

I may mention, in conclusion, that regeneration can be produced also in parts which are not completely separated from each other, so as to form Stentors with two anterior or two posterior ends. Thus, for example, I had divided a Stentor by a longitudinal incision in such a way that one of the two halves, which were still connected behind, retained nearly the whole peristome and the other only a small part of it (fig. 5); the former immediately completed itself again, but in the case of the second half some days elapsed before it had again developed a perfect peristome with the mouth (fig. 6). Thus two perfect Stentors, only united at the base, were produced, and they further contained a connected chain of nuclear joints. Unfortunately I could not keep this pair of twins long alive, as the water in which I had isolated them became foul. In the same way we may succeed by means of incomplete longitudinal sections in producing animals which show two posterior ends attached to a common fore part. However, halves divided in this way do not always remain connected, but usually they tear themselves apart by twisting movements.

I have hitherto spoken exclusively of the regenerative faculty of *Stentor cæruleus*, and now comes the question as to how far this occurs also in other Infusoria. I have already mentioned Nussbaum's experiments, which prove that *Oxytricha* behaves in the same way; I have myself operated with *Stentor polymorphus* and with *Climacostomum virens*, in both of which the parts removed were replaced within twenty-four hours; in *Paramœcium* I also succeeded in removing the anterior end, isolating the posterior end, and finding it regenerating on the next day. On the other hand, there are other Infusoria which present difficulties that are frequently insurmountable. Thus Nussbaum could not keep artificially-divided *Opalinæ* alive, as no cicatrization of the wounded surface took place; ciliary action continued for an hour or two, but then the divided portions perished. With *Loxodes rostrum* experiments in artificial division were equally unsuccessful; these Infusoria usually deliquesce immediately after the section has been made, or if one succeeds in obtaining and isolating divided portions, these perish before any regeneration has taken place.

It is remarkable that *Opalina* and *Loxodes* in particular show themselves to be so little capable of regeneration, as they are both multinucleate, and, as I remarked at the beginning, experiments in artificial multiplication were first made successfully upon multinucleate Protozoa—*Myxastrum**, *Protomyxa*, and *Actinosphærium*.

I have also employed the great Holotrichous Infusorian *Cyrtostomum leucos* in experiments, and observed that in this also the regeneration does not take place so rapidly as in the above-mentioned Heterotricha, *Stentor* and *Climacostomum*; although a new mouth and œsophagus are formed, the body remains deformed for a long time. Even the Heterotricha do not all behave alike in this point, for I never succeeded in multiplying *Spirostomum*, for example, artificially, as it is very difficult to keep isolated in small quantities of water, and even when uninjured soon perishes. *Very probably these differences in the regenerative capacity of the Infusoria depend only on the greater or less faculty of existing under not quite natural conditions, and the power of replacing lost parts is, in my opinion, proper to all Protozoa, notwithstanding the above-cited negative results.*

But if we inquire *why* the Infusoria have so high a regene-

* *Myxastrum* was referred to the Monera by Häckel, as possessing no nucleus; but very probably the nuclei merely escaped his notice, for by the employment of our present methods of treatment they may easily be shown in *Myxastrum liguricum* (see Gruber, "Die Protozoen des Hafens von Genua," in Nova Acta Acad. Leop. Carol. Bd. xlvi. 4, p. 505).

rative power as we have demonstrated, for example, in *Stentor*, this question is not so easy to answer; for when living freely they will rarely have to suffer injuries, or at all events such injuries as we can inflict upon them artificially with the scalpel. In multicellular animals this is quite otherwise; in their case we know that they have very often lost parts of their bodies by violent attacks, and in their case we are not surprised that many of them are endowed with a very highly developed regenerative capacity, which has to play an important part in the preservation of the species. But what is the case in the Protozoa? In my preliminary communication I have already expressed the opinion that *perhaps the acquisition of the regenerative faculty by the Infusoria (and by the Protozoa in general) may depend on the fact that they frequently break up spontaneously into irregular fragments, and that then many of these fragments are able to become developed again into normal animals.*

This spontaneous breaking up is a phenomenon easy of observation in the life of the Infusoria, and one that I have already seen in a number of species; it struck me particularly in the case of a colony of *Oxytricha*, and in this, among the ruins which circulated in the water, I found many which were indeed much smaller than the normal animals, but still more or less regularly formed, so that we may assume that here a regeneration had taken place. I do not venture to draw any more certain conclusion, because at the time I had something else in view, and did not go into this point with sufficient exactness. In other Infusoria, however, the breaking up of the body into small fragments and the subsequent growth of these into normal animals is a regular phenomenon and the ordinary mode of increase, namely in the *Opalinæ*. It is remarkable, however, that these are precisely the Infusoria which, as already mentioned, could not be artificially multiplied; but this does not seem to me to be inexplicable, as the *Opalinæ*, as is well known, are Entozoa, and their natural conditions of existence could hardly if at all be realized for them during the experiment.

If we accept as possible the faculty of the Infusoria to break up spontaneously and to rise again anew from the ruins, we get for them conditions exactly analogous to those of the Metazoa, as may be shown by an example already mentioned by me:—A worm (e. g. *Nais*) can divide spontaneously into two equivalent individuals, just like an Infusorian; a worm (e. g. *Ctenodrilus monostylos* *) can break up spontaneously

* Zeppelin, "Ueber Bau und die Theilungsvorgange des *Ctenodrilus monostylos*," in Zeitschr. f. wiss. Zool. Bd. xxxix. (1883).

into irregular fragments, which then gradually become regenerated into perfect animals; we find the same thing in Infusoria (*Opalina*); and, finally, a worm (e. g. *Nais*) may be cut up artificially into pieces which are able to replace the lost parts; and the Infusoria, as already shown, possess the same faculty. The only difference is that in the regeneration of the Metazoa the cells perceptibly perform what in the Protozoa is the function of the elementary parts.

The Significance of the Nucleus in Regeneration.

When once the general fact of the regenerative faculty was established, the next point was to ascertain the behaviour of the nucleus in regeneration, and its influence, if any, thereupon. In the above-mentioned experiments of the botanists upon the multinucleate cells of *Vaucheria* it had been already pretty certainly demonstrated that in artificial division large nucleiferous portions continue capable of living, while small ones without a nucleus perish; nevertheless it could still be objected that perhaps the smallness of the fragment might cause the want of vitality. The following experiment of Nussbaum's is more conclusive as to the indispensability of the nucleus in regeneration :—" In one instance an Oxytrichine was divided in the direction of its length. On microscopic examination it appeared that all the four nuclei had escaped by the cut surfaces. The fragments were enucleate. The smaller one moved for three hours by the retained ciliary action. The larger fragment lived on until the following day, but had not resumed the Oxytrichine form, as had been the case in all the numerous other experiments in nucleiferous fragments. It moved about in the fluid in the form of a short-tailed sphere. On the second day after the artificial division this piece also had perished." "It would therefore appear," says Nussbaum, " that for the preservation of the formative energy of a cell the nucleus is indispensable." Although he did not choose to state this proposition with perfect certainty, this was probably due to the fact that he could only appeal to a single experiment, in which perhaps inappreciable accidents might have come into play; and therefore I tried whether with *Stentor* any further support for the above-mentioned opinion could be obtained. I was myself not *à priori* convinced of it, for I had frequently had occasion to observe apparently unaltered existence in Protozoa which had lost their nucleus; and I have already described my own and some other observations upon this point under the title of "Ueber die Einflusslosigkeit des Kerns auf die Bewegung, die Ernährung und

das Wachsthum einzelliger Thiere," in the 'Biologische Centralblatt' (Band iii. p. 580), and at the end of the article put forward the proposition "that the nucleus has no importance in those functions of the cell-body which do not stand directly in relation to reproduction."

I said expressly all functions which do not stand in relation to reproduction, and, as will appear hereafter, I had in this judged quite correctly: *a further vegetation and even an increase in size is possible, even without a nucleus, under certain circumstances, but a reproduction or regeneration* (i. e. *a new production of parts of the body*) *cannot occur without the intervention of the nucleus.*

Considerable difficulties lay in the way of the experiments with *Stentor*, inasmuch as the necklace-like nucleus traverses the whole body, and it is therefore difficult to separate a part in such a way that it should contain no portion of the nucleus. I first of all tried to cut away small portions of the anterior part of the body, and I succeeded frequently in avoiding any injury to the nucleus in so doing (fig. 8 *a*). After isolating them I found such small pieces on the following day tolerably perfect in form; I stained them with picrocarmine, when it appeared that they actually contained no nuclear constituent (fig. 8 *b*), and I thought I might now conclude from this that a regeneration might occur even without the presence of a nucleus. I was also led to the same conclusion at first by another experiment:—Starting from the fact that the necklace-like nucleus of the Stentors fuses during fission into a bean-shaped mass, I selected individuals which just showed the commencement of division, *i. e.* in which the middle of the body was just beginning to show a new peristome (fig. 9); in one such individual I succeeded in making a transverse section immediately in front of the foundation of the peristome in such a way that the greater part of the mass of the nucleus was caused to escape. The two portions were isolated, and on the following day both had become quite perfect animals. When stained on the slide * it now appeared that one of these two Stentors actually possessed no trace of a nucleus, while the other contained only a small residue of it. In this case also therefore regeneration had apparently occurred without the influence of the nucleus. On more particular investigation, however, both this and the former

* Stentors may very easily be stained on the slide, as, when flooded with absolute alcohol, they usually remain firmly attached to the glass. In this Infusorian particularly the nucleus takes up picrocarmine with extraordinary avidity, and is always stained dark red before the cytoplasm begins to acquire colour.

experiment appeared capable of another interpretation. In the small pieces separated from the anterior end the perfect appearance on the following day was due not to regeneration, but to simple wound-healing, in the course of which the separated portion of the peristomial circlet had closed up into a circle, and thus an illusory picture of a perfect Infusorian was produced; but a new mouth had not been formed when the original one was left behind by the incision; in short, what had been lost was not replaced by anything new (fig. 8 *b*). In the second case also we have not to do with a regeneration, for in the middle part of the body of the Stentor under experiment a new peristomial area with the adoral zone of cilia was already in course of formation, and the incision, which passed close in front of this rudiment, had actually only divided the *Stentor* into two parts, which would soon afterwards have separated spontaneously from each other. In the portion which had retained the original anterior end it was only necessary for the wound to close up and the body to taper again into the form of the hinder end; in the other the wound also closed, and the accompanying rudimentary peristome simply passed through its further course of development until the formation of the perfect peristomial area and the buccal spiral. From these observations therefore it only appears *that a process of wound-healing may occur in Infusoria even without the presence of a nucleus, and that a process of new-formation, when once in progress, may also continue without disturbance without the help of the nucleus*; the impulse thereto, as we shall see hereafter, has indeed proceeded from the nucleus, but, this being once given, the impulsive element may be removed without at the same time cancelling the movement. At least I think that we cannot interpret the second experiment, which I afterwards often repeated in the same way, otherwise than *that in the new-formation of parts in Infusoria we must see a movement which incessantly presses towards its object when it has once been set going. But such a movement cannot be started*, i. e. "*organula*" *cannot be produced anew, when the nucleus is lost.* This is proved with certainty by the experiments which I will now describe. I cut a small piece off a Stentor in such a manner that no part of the peristomial circlet was separated with it, because this might afterwards have led to mistakes, and I isolated it (fig. 10); it was not regenerated, and on subsequent preparation it appeared that no constituent of the nucleus was contained in it. I repeated the experiment, and again separated from another individual a small portion, on which also there was no trace of peristomial cilia (fig. 11); on the next

day, however, this piece had become regenerated, and on the application of reagents it proved to be nucleated. Further, I cut a Stentor, in the manner above described, into four pieces (fig. 3); next day three of these pieces (A, B, C) were completely regenerated, one of them (D) not so, and this last when stained proved to be non-nucleate, while the three others had retained portions of the nucleus. The non-nucleate piece, which was incapable of regeneration, was not at all smaller than the others and less endowed with vitality on account of smaller dimensions; but all the four portions were of about the same size, and the non-nucleate piece was even of much larger dimensions than many parts separated in other experiments which were very well regenerated *.

The following experiment is still more conclusive as to the importance of the nucleus in regeneration. If we cut away the posterior extremities from a considerable number of Stentors and isolate these separated parts, which therefore retain no constituents of the peristome, we find them next day in different states—some of them have become regenerated into perfect Stentors with a new peristome, mouth, and œsophagus; in others the regeneration is in progress but not yet quite completed; and, lastly, in a third portion we only find that the wound has closed up, the animals swim about like the rest, but no trace of regeneration is exhibited. When stained on the slide it is seen that the perfectly regenerated pieces contain a normal necklace-like nucleus; that those in which the restoration is delayed have only retained a small fragment of nucleus; and that those which prove to be incapable of regeneration are quite destitute of nucleus. I have frequently kept such non-nucleate pieces alive for several days; but they always perished without the occurrence of any new-formations.

I have also undertaken similar experiments with some other Infusoria, but without further results, as they were all less fitted for the purpose than *Stentor*. On the other hand, I succeeded with *Amœba proteus* in obtaining perfectly good results. As is well known, *Amœba proteus* has only a single, tolerably large nucleus †, and for this reason it is not difficult to divide into a nucleate and a non-nucleate half (fig. 12). If the section be made successfully and the two portions isolated, we see that one of them continues without disturbance to push forward and retract its pseudopodia (A), in short it has undergone no change in its habit; while in the other portion

* I may mention that I several times repeated this and the following experiment in order to insure myself against possible accidents.

† Gruber, "Studien über Amöben," in Zeitschr. f. wiss. Zool. xli.

(B) the pseudopodia disappear, although a feeble flow of protoplasm is at first still visible, and in course of time the fragment dies completely. I divided such an *Amœba* on April 14; on the 16th the one half was as active as at first, but the other had become globular and was in course of perishing; when stained the former proved to be the nucleate and the latter the non-nucleate half; and the same result was furnished by all other experiments *. *Here, therefore, the removal of the nucleus also immediately superinduces an alteration of the mobility, which will not be the case in the Infusoria or probably in most Protozoa*, at least even in Heliozoa I have seen non-nucleate fragments move as freely as the nucleated ones. *But what is superinduced in all Protista, and generally in every cell, by the want of the nucleus is the incapacity to replace lost parts, to produce new structures.*

Thus for the "maintenance of the plastic energy of a cell," as Nussbaum expresses it, the nucleus is, in fact, indispensable; and we may say with Weismann †, that "only under the influence of the nucleus the transformable cell-substance again acquires the full specific type." *By a purely empirical course we are here placed before the incontrovertible fact that the nucleus is the most important and the species-preservative constituent of the cell, and that to it is justly ascribed the highest importance in the processes of fecundation and inheritance*, as has been done of late by many naturalists.

As the directing influence in the increase of cells emanates from the nucleus, it appears wonderful that the nuclear substance is often distributed in more or less numerous fragments in the protoplasm, so that, to a certain extent, instead of a monarch, an oligarchy exists in the cell, which, we might suppose, could easily produce a confusion in the development. Perhaps, to obviate this and also to permit a uniform distribution of the nuclear substance in the daughter-individuals, in most multinucleate Infusoria we observe a preliminary union of the numerous nuclei into *one*. When this amalgamation does not take place during multiplication ‡ we must conceive of all the nuclei of the same

* In his "*Amœba villosa*," Wallich twice observed a spontaneous division without participation of the nucleus, in which the two daughter-individuals behaved in exactly the same way as those artificially produced; whether the non-nucleate portion afterwards perished is not mentioned (see Wallich, "*Amœba villosa*, &c.," in Ann. & Mag. Nat. Hist. ser. 3, vol. xi. p. 444.)

† Weismann, 'Die Continuität des Keimplasmas als Grundlage einer Theorie der Vererbung,' Jena, 1885, p. 29.

‡ According to Bütschli, as is well known, the nuclei do not become amalgamated during fission in *Loxodes rostrum*. I have also always found individuals of this Infusorian which were just engaged in dividing, to be

cell-individual as perfectly congruent in structure and function. Moreover, in most multinucleate Protozoa the nuclei appear to the observer congruent in structure, for there are generally no data from which to demonstrate any differences. For this reason it was interesting to me to find in the two nuclei of *Amœba binucleata* an object which may be investigated from this point of view. As I pointed out in my description of this remarkable *Amœba* *, the nuclei, two of which are present, are very large, and are distinguished by a very variable form and arrangement of the chromatic substance, and it appears that the two nuclei of the same *Amœba* always agree in this respect (fig. 13). For example, if the chromatin is distributed in the nuclear fluid in larger and smaller fragments, this is the case in both nuclei (*a*); if it is broken up into a finely granular mass (*b*), if there is a central nucleolus-like lump in the nucleus (*c*), or if the chromatic substance is deposited towards one side (*d*), the two nuclei always agree with each other. *Here, therefore, we can definitely prove the congruence of the nuclei; and I believe that it also furnishes a proof that the chromatin in the nucleus is an important factor, that something depends upon the kind of its substance, and we have not to do with a mere accumulation of nutritive material.*

It still remains for me to say something about the part which the *subsidiary nucleus* has to play in the regenerative processes; but I am unfortunately not in a position to say anything positive about it.

Until quite recently nothing was known of *subsidiary nuclei* in *Stentor*, and only Maupas † has made any statements regarding them, in which he describes the subsidiary nuclei as separate granules irregularly distributed, one or more of which lie in the neighbourhood of each joint of the nucleus.

Balbiani did not succeed in confirming Maupas's observation, but I have repeatedly been able to convince myself of its correctness. Very frequently, although not always, my preparations showed, coloured red with carmine, corpuscles agreeing with those described by Maupas, as I could perceive

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multinucleate. Nevertheless the fusion and subsequent reseparation into numerous nuclei might have already taken place before the commencement of division became visible on the body of the Infusorian, just as I have described in the case of *Oxytricha scutellum* (Gruber, "Ueber Kern und Kerntheilung bei den Protozoen," in Zeitschr. f. wiss. Zool. Bd. xl.).

* "Studien über Amöben," &c.

† Maupas, "Contributions à l'étude morphologique et anatomique des Infusoires ciliées," in Arch. de Zool. Exp. et Gén. sér. 2, tome i. pp. 652 *et seqq.*

from the drawings which that naturalist was kind enough to send me. Notwithstanding the small size and often very irregular distribution of these structures, it seems to me very probable that they must be regarded as subsidiary nuclei. But this can be said with perfect certainty only when we have succeeded in tracing their behaviour during the division and conjugation of the Stentors. As regards regeneration, I could discover no sort of influence that they were able to exert upon that process.

Observations upon the Spontaneous Division of the Infusoria.

So far as I know, no experiments have been made in order to ascertain whether in the multiplication of the Protozoa by division there exists any regularity as to the time in which the divisions follow one another, whether a definite number of divisions occur between two periods of conjugation, whether the occurrence of division is caused by increased nourishment and the growth consequent upon this, or, on the contrary, by unfavourable external circumstances, or whether it is not at all the consequence of external impulse, but is governed and produced by internal causes. These and many other questions are still unanswered, and even the experiments which have been undertaken for their solution have at present made only a slight commencement, so that they can make no claim to completeness, seeing that they have not furnished the opportunity of completing them by more perfect ones. *Stentor cæruleus* again served me as my chief object of experiment; I had it in abundance at my disposal, and from its considerable size it could be easily isolated and watched.

One series of experiments consisted in isolating Stentors, and indeed, if possible, such as were just about to divide; when the division took place the daughter-individuals were separated and observed by themselves, in order to see how and when their division into grandchildren took place. It appeared *that this took place, in most cases, simultaneously in the daughter-individuals*, although they were kept in separate glasses. By "simultaneously," however, I do not mean that the division takes place in both Infusoria at the same moment, but perhaps within an hour or in the course of a few hours, but at any rate on the same observation-day, which I will reckon as from 9 A.M. to 4 P.M. Very often also the isolated individuals divided during the night, and in the morning I found both daughters divided into two granddaughters. The small differences of time which occur between the divisions of

the daughter-individuals are of course increased in the following generations, so that in the case of the granddaughters and great-granddaughters of a common ancestral individual we can no longer speak of simultaneous division; in these differences of many hours and even of days occur. As the same share of nuclear substance falls to the two congruent halves into which the Infusorian breaks up in division, and indeed, as we assume, to each of them one of the morphologically and physiologically equivalent halves of the original nucleus, it might be supposed that under the same external conditions therefore (for example, those of common residence in a very small quantity of water) the daughter-nuclei must be absolutely alike in the exertion of their dominion over the plasma, and therefore in their influence upon division, so that in the daughter-individuals increase will take place at the same moment. Why small differences should occur I cannot at present say definitely; I believe, however, that in this circumstance we may see an indication *that the morphological and physiological congruency of the two daughter-individuals produced by division is by no means quite an absolute one.*

I may remark further that in other Infusoria, such as *Clymacostomum*, *Stylonychia*, and *Paramœcium*, I have also been able to prove the (nearly) simultaneous multiplication of the daughters of the same individual.

As regards the time that intervenes between the different divisions, I can only say anything definite in relation to *Stentor*, as this, hitherto, is the only Infusorian in which I have succeeded in making a number of observations upon this point. Singularly enough it appeared that *division took place in most cases at intervals of two days*, that daughter-individuals divide into granddaughters on the second day after their separation, and granddaughters in another two days into great-granddaughters, and so forth. *In forty-two out of fifty-six cases division took place always on the second day after the preceding one*; six divided as early as the next day, five only on the third, and three after four, five, or more days. In *Stentor cœruleus* therefore we may almost regard it as the rule that the above-mentioned interval of time is maintained between each two divisions. The question now, however, is whether this phenomenon is normal, or whether it is called forth by unnatural conditions of existence. This is difficult to decide, as these investigations can only be made on isolated animals, and therefore on animals living in small quantities of water. But even if we suppose that the small quantity of water has produced the tendency to rapid division, this would only lead to the assumption that this tendency may also occur in nature

when from any circumstances the pool, brook, &c. was nearly dried up; the regularity with which the divisions follow one another in time is not thus explained, and *this can apparently only be the expression of a constantly acting internal law.*

The absence or presence of nutritive material for the Stentors was in all these experiments without influence upon the time of the division. I had isolated animals in watch-glasses containing nearly pure water, and in others in which the water swarmed with *Paramœcia* (a chief food of the Stentors) and other Infusoria; but in both the multiplication went on in the same manner, and indeed always so that the animals did not grow between two divisions, and therefore lost in volume from one division to the next. I have frequently made measurements of the individuals under experiment before isolation, measuring them while swimming about, when they present a mean state of extension; then the daughters, granddaughters, &c. were also measured, and it was found that the volume decreased to about one half, then to a quarter, and so forth. I say about, because the animals produced by division appeared a little larger than the corresponding fragments, which may be due probably to inception of water. The Stentors which I isolated were generally nearly of the same size, and they divided only to the third generation, so that the last generations in these experiments were always nearly of the same dimensions.

If I isolated smaller animals, they divided only to the second generation, which also again showed the smallest measurement.

I believe there is no doubt that in these phenomena a normality is expressed, and that we have not to do with the products of accident. Even in the aquaria in which the colonies of *Stentor* live under natural conditions of existence we often find the Infusoria of very small average size, and it may very well be that these had just been subjected to a rapid sequence of divisions. *I believe that among the Infusoria we may distinguish two kinds of spontaneous division, one of which occurs when the individual by growth has attained a certain size which cannot be exceeded*; this is the multiplication which has been characterized as the growth of the individual beyond the prescribed measurement. *A second mode of increase is by divisions following upon one another rapidly and in definite intervals of time without intervening growth, and therefore combined with continual decrease of the size of the body down to a definitive smallest measurement.* This latter mode of multiplication, of the existence of which I have already furnished proof, will occur when the Infusoria are placed under un-

favourable conditions, and it seems desirable, for the preservation of the species, to produce a great number of individuals very rapidly. At the close of these hurried divisions a period of conjugation would then occur, and this, as is well known, has always been observed in very small individuals. If the last-mentioned mode of increase were the sole one, we should always observe in every colony of Infusoria a diminution of the individuals combined with an increase of their number, and an equally regular cyclical recurrence of the period of conjugation. But every one who has been long occupied with the Infusoria knows that this is not the case; and it is particularly well known to those who have for a long time observed colonies rich in individuals and constantly increasing, and sought in vain for conjugation-states, which at other times had been present in great numbers.

I must not, however, develop these ideas any further, for, as already remarked, the empirical facts from which they proceed still stand on too weak a foundation, and I will rather wait until time and opportunity may furnish me with suitable material for working further upon them.

On the Nervous System of the Infusoria.

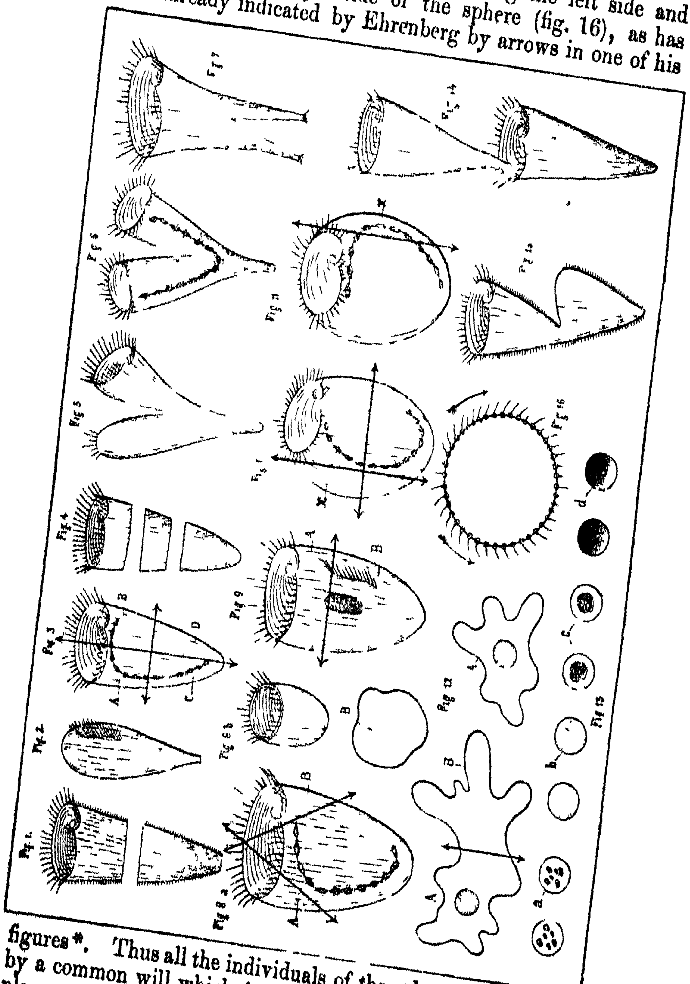
In my experiments with Stentors my attention has been called to a question which I would here briefly touch upon, namely, what may be the nature of the nervous elements in the cell-body of the Infusoria? Some light is thrown upon this by the behaviour of the Infusoria during conjugation and spontaneous division, as I have already indicated in my preliminary communication above referred to. Thus if we observe a pair *in copulâ* or an Infusorian engaged in division in which the two halves are not yet completely separated, one is struck with the fact that these animals move exactly like a single individual, *that both of them make exactly concordant movements so long as they are still united by a bridge of protoplasm.* I have frequently traced this in different species of Infusoria; but here, again, the Stentors are particularly adapted to the purpose, as the movements are so distinctly to be detected under the microscope in the great peristomial cilia. So long as the two daughter-individuals are united by even the thinnest thread of protoplasm (fig. 14) they behave precisely like a single individual; if the peristomial cilia of the anterior half strike forward, so also do those of the posterior, and at the same moment in which the former, from any cause, change the direction of their motion, so also do the latter. The natation is therefore perfectly

uniform, and the two animals glide quietly through sand-grains, filaments of algæ, &c., one after the other. But if the anterior one meets with an obstacle, stops and swims backwards, the posterior Infusorian does this also at the same time. It is therefore not as if the second individual simply followed the first, and if the first can go no further the second would still endeavour for a time to swim forward until it is held back. If one of the halves shrinks together in consequence of an unpleasant contact, the other does so also at the same moment; in short all the movements are perfectly synchronous until the last uniting threadlet is ruptured between the two individuals, each of which then swims away in a different direction. The same result is obtained if we succeed in making a transverse incision in a Stentor in such a manner as to produce two halves, which, as in spontaneous division, are united by a narrow bridge of protoplasm (fig. 15). Then also these two loosely connected pieces move quite uniformly, and one of them does not attempt to swim backwards while the other steers forwards. As in this case the posterior half lacks the peristome, the simultaneous movements are performed by the body-cilia. If then, as these observations show, a very slender and even thread-like bridge of protoplasm suffices to cause the loosely connected pieces to behave as one physiological individual, this proves that *the nervous functions in the Infusorial body are not confined to definite courses, and that the exertion of will uniformly governs every protoplasm-element.* Consequently no circumscribed central organ can be present; but every plasmatic particle is a central organ and conductor in one, i. e. *the nervous potency of the cell is diffused.* This does not render it impossible that at the same time *threads* of nervous nature may exist, as for example in the case of the innervation of cilia which have to beat at unequal times, as Engelmann believes he observed to be the case in *Stylonychia**.

This assumption also explains how it is possible that swimming colonies of Protozoa are able to perform movements in accordance with a purpose. For example, if we observe a *Volvox*-sphere, which may consist of many hundred individuals, we see that in its movements it behaves no otherwise than as a holotrichous Infusorian; the sphere swims forwards and backwards, turns in a circle, remains still when necessary, according as some obstacle stands in its way or the course is free. But as the individuals are situated on the surface of a sphere they cannot all strike in the same direction with their flagella, but the movements of these must compensate

* "Zur Anatomie und Physiologie der Flimmerzellen," in Pflüger's Arch. für Physiol. xxii. (1880) p. 505.

each other; and in a colony swimming straight forwards we see those on the left side striking to the left, and the others to the right, so that a current glides along the left side and another along the right side of the sphere (fig. 16), as has been already indicated by Ehrenberg by arrows in one of his



figures*. Thus all the individuals of the colony are governed by a common will which is diffusedly inherent in the protoplasm, and which can only embrace all the members of the colony in this way, *because the latter are united to each other*

* Die Infusionsthierchen, 1838, Atlas.

by cords of protoplasm. I am convinced that these bridges serve much more for the establishment of a nervous unity than for the reciprocal nourishment of the individual animals.

In the higher Protozoa, and therefore in the Infusoria, it seems to me probable that *the seat of the diffused nervous potency is chiefly to be sought in the cortex.* Thus certainly this and not the parenchyma is alone capable of delicate sensibility, otherwise the frequently observed inception of inordinately large nutritive bodies must be attended by painful sensations. Further, this swallowing of bodies which extend and rupture the Infusoria shows us at once that we need not expect to find in the parenchyma any differentiation into special organula, fibres, &c. I once made a very instructive observation in this direction upon a *Clymacostomum virens.* This Infusorian had swallowed a single wheel-animalcule, which was rushing about in the parenchyma as if mad, stirring up everything, and sometimes pushing out the cortical zone, sometimes drawing it in by means of its rotatory organ. The *Clymacostomum,* however, seemed to be no further troubled by this riotous guest in its interior, for it swam about in the water quite quietly and uniformly. But while other animal prey, such as small holotrichous Infusoria, which were frequently devoured by the same individual, were digested in a short time (about a quarter of an hour), the wheel-animalcule remained alive for twenty-four hours; it lay quiet indeed, but the rotatory organ was still in motion. Of course, in such a long time it must have produced sad ravages in the body of the Infusorian if any complex structures had been present therein. But the only thing observable in the *Clymacostomum,* which was still very lively, was that at the posterior extremity, where the wheel-animalcule lay, the body was somewhat indented; but this had disappeared on the following day when the animalcule had died and been digested.

Let no one who is paying attention to the Protozoa omit seizing upon such chance observations as the above, for it is by them we shall most readily get to understand when and how the vital phenomena are performed in the simple but enigmatical protoplasmic body of the "unicellular animals."

XLV.—*On a new Species of* Psilotites *from the Lanarkshire Coal-field.* By Robert Kidston, F.G.S.

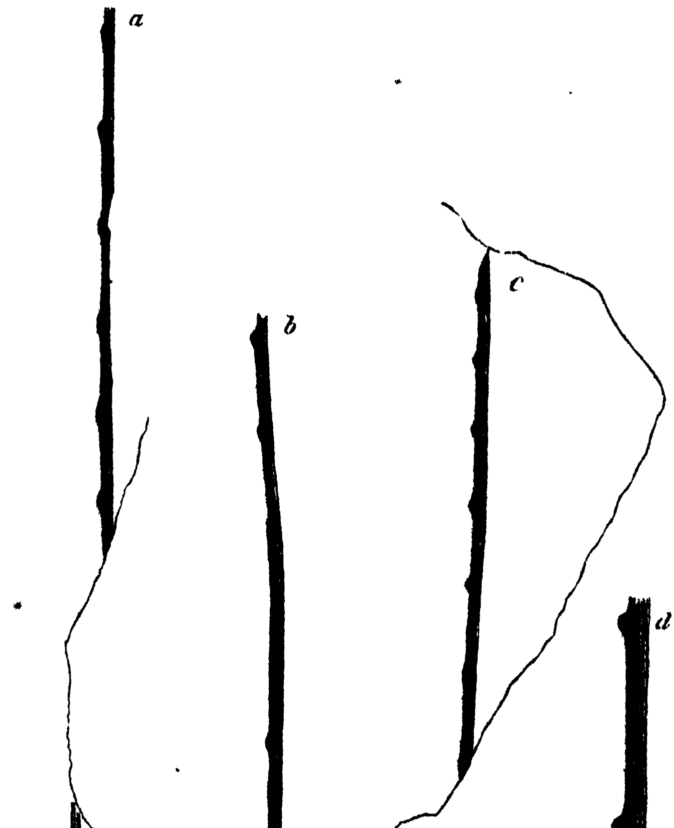
Psilotites unilateralis, Kidston, n. sp.

Description. Stems narrow, irregularly striated, provided with a lateral row of thorn-like projections.

Remarks. The specimen shows portions of three stems

about 1 millim. wide, lying parallel to each other, and about 4 centim. apart. The fragments of these stems are each about 7 centim. long; but in no case is their upper extremity or their attachment to the parent branch shown. That they originally sprang from a common stem is probable from their relative positions.

On the branchlet lettered *a* (see sketch*) are seen the remains



of six thorn-like projections; these are 12 millim. apart; on that lettered *b* four are shown, but there has evidently been another between the third and the fourth; these are from 12–13 millim. apart. On the remaining stem, *c*, seven of these

* The branchlets have been approximated, to enable them to be brought into the woodcut.

thorn-like growths are apparent, distant from each other 9–12 millim. Towards the upper part of this branchlet they become less distant from each other. These projections appear as round-pointed flat thorns, arising from the stem at almost right angles, and forming a single vertical row. On all the branchlets they occupy a similar side. The stems are strongly marked with irregular vertical striations or ridges (*d*, enlarged).

I have placed this plant in *Psilotites* as employed by Goldenberg *. The stems of Goldenberg's species divide dichotomously; but the dichotomies in his specimens are often very unequally developed; hence some of the branchlets assume the appearance of a lateral ramification.

In the present example, as the attachment of the three branchlets to their parent stem is not shown, and as an unequally-developed dichotomy might produce three branches holding the same relation to each other as those of *Psilotites unilateralis* †, I think that this fossil may, at all events for the present, be conveniently placed in the genus *Psilotites*, whose true affinities, however, to the recent *Psilotum* are somewhat problematical.

What the real significance of these thorn-like protuberances is, whether rudimentary leaves or abortive branches, I am not in a position to decide.

The general appearance of the branchlets of *Psilotites unilateralis* reminds one much of Dawson's genus *Psilophyton*; but the curious arrangement and form of the thorn-like protuberances point to greater affinities with the genus *Psilotites*, as employed by Goldenberg.

Till more complete examples of this interesting plant be discovered its true affinities cannot be definitely decided.

The only specimen I have seen is that figured, which was found by Mr. Walter Burns in 1884, who sent it to Mr. John Young, F.G.S., Hunterian Museum, Glasgow University, by whom it was communicated to me for examination.

Horizon. Coal-measures.

Locality. Baillieston Pits, Lanarkshire.

* 'Flora Saræpontana fossilis: Die Pflanzenversteinerungen des Steinkohlengebirges von Saarbrucken,' Heft i. p. 18 (1855).

† A similar apparent lateral ramification, arising from unequal dichotomy, occurs in the fronds of most ferns.

XLVI.—*Characters of undescribed Coleoptera in the British Museum.* By Charles O. Waterhouse.

Lucanidæ.

Sclerostomus Buckleyi, n. sp.

♂. Niger; capite opaco, pone oculos tuberculo armato; thorace æneo tincto, disco castaneo; elytris olivaceis, nitidis, fortiter punctato-striatis.

Long. (mand. incl.) $12\frac{1}{2}$ millim.

♀. Niger, latior: capite confertim punctato; thorace creberrime punctato, disco plus minusve ferrugineo-rufo; elytris ferrugineo-rufis, creberrime punctatis, sutura nigra.

Long. 10–$11\frac{1}{2}$ millim.

♂. Elongate, parallel, convex. Mandibles as long as the head, pitchy red in parts, thick, curved, concave on the inner side; the upper edge having (about the middle) an erect lamelliform process, concave on the inner side, its two angles produced and diverging. Head dull, gently concave, with a few small punctures in front and at the sides; between the base of the mandible and the eye there is a slight shining tuberosity with a deep impression behind it. The ocular canthus is laterally prominent, like a small tubercle, and behind the eye there is a dentiform tubercle, which projects a little more than the ocular canthus. Thorax a little wider than the head, nearly twice as broad as long, moderately convex, slightly shining, sparingly and very delicately punctured, a trifle narrower in front than behind, all the angles obtusely rounded; the lateral margins narrowly reflexed; disk with a shallow punctiform impression on each side; the front with a raised prominence, which is slightly divided at its apex. Scutellum black, shining. Elytra dark olive-green, shining, parallel, perpendicularly deflexed at the sides; the striæ deep and very strongly punctured; interstices very convex, with scarcely any trace of punctuation. Metasternum very sparingly punctured near the middle; the punctures are very delicate, more distinct at the sides. Middle and hind femora slightly pitchy below.

♀. Oblong-ovate, gently and regularly convex. Head densely and strongly punctured, not concave. Thorax very broad, gently convex, with a shallow, median, impressed line behind, closely and strongly punctured, gently arcuate at the sides; black, with the disk on each side dull rusty red; the anterior angles very slightly advanced, the posterior angles

rounded. Scutellum punctured in the middle. Elytra strongly and closely punctured; on the back two or three lines of punctures may be traced.

Hab. Ecuador, Chiguinda (*Buckley*).

Allied to *S. cruentus*, Burm.

Rutelidæ.

Antichira Adamsii.

Oblongo-ovata, nitida, olivaceo viridique mutabilis, elytrorum limbo vittaque suturali flavis.

Long. 12 lin.

A very distinct species, perhaps most nearly allied to *A. cuprina*, Casteln., but quite different in coloration. Clypeus rather densely and moderately strongly punctured; forehead less closely punctured. Thorax delicately punctured on the disk, the punctures not very close together; towards the sides the punctures become stronger and closer together, but not crowded, except close to the incrassate margin. The base is abruptly sinuate on each side of the scutellum, and slightly but distinctly impressed; the basal lobe is broad, truncate, and very gently sinuate. Scutellum not quite one third the length of the elytra, not quite so broad as long, acuminate and slightly cordiform, very delicately punctured. Elytra moderately convex, deflexed at the apex, the punctuation fine but moderately distinct; the sides near the apex and the apex itself rather closely and more coarsely punctured; each elytron with six lines of fine but very distinct punctures. The colour varies from brownish green to yellow-green according to the light in which the insect is held. The sutural yellow stripe is broader at the scutellum than at the apex. Some specimens have two or three very narrow yellow lines on the disk. The pygidium is very coarsely, closely, and transversely vermiculate-strigose, especially in the male. The underside of the insect is somewhat coppery. The sternal process is rather long, scarcely curved, very slightly inflated at the apex.

Hab. Colombia.

Lycidæ.

Calochromus terminatus, n. sp.

Elongatus, angustus, niger; thorace elytrisque rufis, his apice nigris.

Long. 7–10 millim.

Very near *C. ruber*, Waterh. (Ill. Typ. Col. in Brit. Mus.,

Lycidæ, 1879, p. 4, pl. i. fig. 6), and belonging to that group in which the head is concealed by the front margin of the thorax. It differs from *C. ruber* in having the thorax less densely pubescent, so that it is slightly shining, and the median channel is much deeper. The scutellum is black, with very little red pubescence. The elytra have only two costæ on each, and these are not very well marked; the extreme apex is blackish; in one specimen the black is only on the suture. The antennæ reach to about the middle of the elytra, are moderately stout, but not quite so broad as in *C. ruber*. In the male the fifth joint of the antennæ is about twice as long as broad; in the female it is rather shorter.

Hab. Ceylon (*Percy Braine, Esq.*).

Calandridæ.

Poteriophorus Bowringii, n. sp.

Indumento crustaceo ochraceo undique tectus; thoracis elytrorumque lateribus fusco suffusis. ♀.

Long. (rostr. excl.) 26 millim. ($12\frac{1}{2}$ lin.); lat. elytr. 11 millim.

Closely allied to *P. niveus*, but broader and of a rich yellow colour. Rostrum stouter and much wider in front of the eyes. Thorax relatively broader, with no distinct punctuation; sides gently arcuate and not parallel posteriorly. Elytra much broader at the base, but narrowed posteriorly; the sides clouded with brown, with yellow dots here and there. Pygidium more convex, with a few obscure punctures near the base. The punctures bordering the upper margin of the metathoracic parapleura are large and deep. Prosternum with scarcely any trace of hair; prosternal process very prominent, strong, conical, the apex slightly bent forwards. Apical segment of the abdomen with a rather large shallow depression at the apex, the sides of the depression bordered by closely-placed, small, scale-bearing punctures.

Hab. Java (*J. C. Bowring, Esq.*).

I have compared this species with *P. niveus*, as that species is well known; but it is really more nearly allied to *P. imperatrix*, White, having the same general form and also a prosternal process. In *P. Bowringii*, however, the process is thick and erect, whilst in *P. imperatrix* it more resembles a ridge, terminating at some distance from the coxæ in a small tubercle.

Poteriophorus fusco-varius, n. sp.

Indumento crustaceo sordide albo tectus, plus minusve ochraceo

tinctus; thoracis lateribus, elytrorum marginibus, apice fasciaque mediana fuscis. ♂.

Long. (rostr. excl.) 21 millim. (10 lin.); lat. elytr. 9 millim.

Very near *P. niveus*, but quite differently coloured. The general colour is pale sandy yellow, which is darker in some places. The sides of the thorax are dark fuscous, and this colour is carried along the margin of the elytra and entirely covers the apex; the dark colour is more extended on to the elytra about the middle, and there is a V-shaped fuscous mark on the back of the elytra; there are also a few fuscous spots near the scutellum. The rostrum is short and very thick at the base. The ocellated punctures on the thorax are irregularly placed and are not very numerous. The pygidium is strongly punctured, and has a strong ridge in the middle which reaches nearly to the base. The vertical process behind the anterior coxæ is elongate and acuminate. The punctures along the upper margin and at the posterior part of the metathoracic parapleura are very strong.

Hab. Borneo (*J. C. Bowring, Esq.*).

Cerambycidæ.

Oxymerus Saundersii, n. sp.

Rufo-flavus, nitidus; antennarum dimidio apicali, thorace guttis septem, abdomine, tibiis posticis tarsisque nigris; elytris pallidioribus, sutura apiceque nigris.

Long. 8½ lin.

Thorax with the lateral tubercle rather prominent, as in *O. Chevrolatii.* The anterior discoidal impression of the thorax very deep and bounded on each side by a well-marked ridge; posterior depression very deep. Elytra paler than the thorax, very delicately and not very closely punctured; the apex and the suture black, the black becoming very narrow at the scutellum. Each elytron has three pale yellow lines. Metasternum and abdomen black.

In one example the antennæ are black, with the base of the first and the middle of the second joints red. The black on the elytra is also interrupted at the apex, and is confined to the suture and a spot on the outer apical angle.

Hab. Corrientes, Argentine Republic (*W. Saunders*).

I have named this species in remembrance of the late William Saunders, formerly of the Entomological Department, British Museum.

Lamiidæ.

Sternotomis picta, n. sp.

Nigra; pube olivaceo-prasina induta, maculis ferrugineo-ochraceis ornata, maculis nigro cinctis.

Long. 14 lin.

Very near *S. principalis*, but differs chiefly in having the whole of the sides of the thorax yellow, and all the spots on the elytra larger and uniform in colour. Thorax with two short oblique black marks on the disk; the base, the sides, and the front margin (except in the middle) yellow. Elytra with a large triangular yellow patch (common to both elytra) occupying nearly the whole of the base, only leaving a dark spot at the base of each elytron. Beneath the shoulder is a lunate spot (representing the two spots of *S. principalis* united). The fascia at the middle of the elytra is about 3½ millim. broad on the margin, increasing to 5 millim. in the middle, then narrowed to the suture. There is a moderately large spot close to the suture, a triangular spot on the margin, with a small spot on the disk behind these, and an irregular-shaped spot at the apex, representing the two apical spots of *S. principalis* united.

Hab. W. Africa, Fernand Vaz River (*Du Chaillu*).

Sternotomis Bohndorffi, n. sp.

Nigra, pallido æruginoso-pilosa, fasciis plagisque lurido-albis. Long. 15 lin.

Very near *S. Bohemani*, but larger, and with the brown markings of that species replaced by dirty yellowish white or pale sand-colour. Head entirely clothed with this pale colour, except a pale green stripe on each side of the face. Thorax with the front margin, a median and a basal fascia pale, thus leaving two narrow fasciæ and the margin of the basal lobe pale green. Elytra strongly punctured, the punctures rather close together; the parts that are not occupied by the pale markings appear almost black, but are thinly covered by a very pale green pubescence. The pale markings are thus:—a broad basal fascia; a second fascia, not quite united to a spot below the shoulder; a third oblique fascia, touching the margin but not the suture (sometimes united by a branch to the second fascia); a large spot on the suture (common to both elytra, sometimes united to the apex of the third fascia); a fourth oblique sigmoid fascia (almost divided into two spots) touching the margin and nearly reaching to the sutural spot; a second small sutural spot; a fifth oblique straight fascia (united on the margin to the fourth), not reaching the suture; a large V-shaped mark at the apex. Male with a large tooth on the mandibles. Prosternal process very prominent and emarginate at the apex.

Hab. Central Africa, Niam Niam Country (*F. Bohndorff*).

XLVII.—*Descriptions of Sponges from the Neighbourhood of Port Phillip Heads, South Australia, continued.* By H. J. Carter, F.R.S. &c.

[Continued from p. 441.]

Order VIII. CALCAREA.

Structure composed of contorted, repeatedly branched, anastomosing, tubular threads, forming a reticulated mass which at length assumes a more or less definite form.

1. *Clathrina* cavata.*

Individualized. Massive, compressed or round, contracted towards the base; composed of tortuous, hollow or tubulated thread-like filaments, almost infinitely and irregularly branching and anastomosing; compactly reticulated above, becoming looser and more open in structure below, where it finally ends in a few of the same kind of hollow filaments, which are attached to the object (mussel-shell) on which it may be growing. Colour sponge-brown when fresh, lighter when dry. Surface even, irregularly reticulated. Pores numerous, passing *through* the wall of the hollow thread. Vents of two kinds, viz. spurious and real; the former more or less in plurality scattered over the surface generally or confined to the upper border, consisting of short, thin-walled, cylindrical prolongations extended from the *outside* of the wall of the tubulated thread, which prolongations are in direct communication with the interstices of the reticulated mass generally, but more especially with dilated portions of this mass extending for a short distance inwards in the form of a cavity; *real* vents consisting of circular holes here and there in the wall of the reticulated tubulation, which not only open into the so-called cavities or dilated portions, but in all probability exist throughout the structure, where they would open into the interstices generally of the reticulated mass. Structure that above mentioned, whose staple is the "tubulated thread," of which the wall is very thin and skeletally composed of a single layer of radiate spicules held together by sarcode supporting the softer parts, which here appear to consist chiefly of a layer of spongozoa in juxtaposition, and not gathered into the form of ampullaceous sacs, together with a remarkable quantity of those organs which consist of nucleated cells surrounded by an abundance of glistening spherical granules, which Häckel has figured and named

* Dr. J. E. Gray's name for this kind of sponges (see 'Annals,' 1884, vol. xiv. p. 17 &c.).

"nuclei" (Kerne) of his "syncytium" (*op. cit.* 'Atlas,' Taf. i. fig. 3). Spicules of two forms, viz. triradiates and quadriradiates, the latter in very subsidiary quantity. Triradiates comparatively small, variable in form and size, but chiefly equiarmed and equiangled. Quadriradiates about the same size. Ray of the largest triradiates on the surface about 30 by 4½-6000ths. The latter composing the skeletal structure of the tubulation generally, the former sparsely scattered throughout, but most numerous about the "spurious vents," apparently without any particular position, as the fourth arm appears here and there, both inside and outside the wall of the tubulation, and the same about the cylindrical prolongations or spurious vents. Of this species there are four specimens, the largest of which is compressed and somewhat triangular in shape, 1½ inch high by 2 × ½ horizontally at the upper border.

Obs. This is evidently a representative of the *Clathrina* which grows so abundantly on the under surface of rocks in this neighbourhood, viz. Budleigh-Salterton ('Annals,' 1884, vol. xiv. p. 18); but as there appear to be no rocks at the sea-bottom in Australia, where it was dredged, it grows on shells or the agglomerated material of these parts. Moreover, it differs from the *Clathrina* of this place, in which the cylindrical prolongations on the surface are in *direct* continuation with the *interior* of the tubulation, like that of the next species that will be described, while in *C. cavata* they are *only* in communication with the *dilated parts* of the interspaces.

We have evidently here a foreshadowing of the vent and cloaca, which are more perfectly developed in *C. tripodifera* and following species.

It belongs to Häckel's Ascones of course, and seems, but for the presence of the spurious vents, to be almost identical with his *Ascetta clathrus* (*op. cit.* Atlas, Taf. iv. figs. 1–3). As for the difference in spiculation which the presence of the quadriradiates makes in Häckel's classification, this may be cancelled under the view that it is a "connective variety," like his *Ascetta primordialis* (vol. ii. p. 17).

2. *Clathrina osculum.*

Individualized, social. Globular, stipitate, presenting on the summit a short, cylindrical, hollow process, and ending below in one or more filiform stems fixed to the object on which it has grown, composed throughout of a mass of tubulated thread-like filament growing by almost infinite and irregular branching and anastomosis into the form above

mentioned. Colour sponge-brown when fresh, when dry dark grey. Surface even, uniformly reticulate, interstices about 1-120th in. in diameter. Pores numerous, passing *through* the wall of the hollow thread. Vent single, tubulated, at the summit of the specimen, composed of a thin, cylindrical extension of the *walls of the tubulation*, which at this part opens into it by a plurality of holes, and thus enters into its composition. No defined cloacal dilatation. Structure already stated, composed of the same kind of staple thread as *C. cavata*, but smaller and more compact in its reticulation; wall of the tubulated thread very thin and skeletally composed of a single layer of triradiate spicules held together by sarcode, and lined by the softer parts, which here also appear to consist chiefly of a layer of spongozoa in juxtaposition, that is without being gathered into the form of ampullaceous sacs, together with a remarkable quantity of those organs which consist of nucleated cells respectively surrounded by an abundance of glistening spherical granules, which Häckel has figured and named "nuclei" (Kerne) of the syncytium, as before stated. Stem apparently an extension of the tubulated thread, but more solid. Spicules of one kind only, viz. triradiates of different sizes, but for the most part equiarmed and equiangulated, intercrossing each other on the surface so as to give the interstices of the reticulation here a polygonal border; spicules more plentiful and *larger* than in *C. cavata*, ray of the larger ones averaging 42 by 5-6000ths in. in its greatest dimensions. Size of individual, of which there are two joined together, about 5-24ths in. in diameter; stem about 1-24th in. long and 1-48th in. in diameter.

Obs. To what size this species might ultimately grow I am ignorant, but that above described appears to be very small. It is, however, amply large enough to show in the section that the tubular vent is the *outlet of the tubulated structure*, and that, although there is no absolutely cloacal dilatation, this is indicated by the reticulated structure in the centre immediately under the vent being more open than towards the circumference. In these two particulars, then, it differs from *C. cavata*, not more so, perhaps, than in the size and abundance of its spicules, especially on the surface, whereby the thickness of the wall of the tubulation here appears to consist of a plurality of layers instead of one only as in *C. cavata*. The tubulation is charged internally with *ova* in the unsegmented state, large, and presenting the germinal vesicle.

Upon the authority of Häckel I have stated that the "nuclei," mentioned in the two last species, are in his "syn-

cytium;" but, entertaining a different view of their nature, I must refer the student for my explanation of this assumption to the 'Annals' of 1884, vol. xiv. pp. 20 and 21. The species is very like Schmidt's *Nardoa reticulum* (Spong. Küste v. Algier, p. 28, Taf. v. figs. 7 and 8).

3. *Clathrina tripodifera.*

Conical, rather compressed, sessile, fixed, with cloaca and wide mouth; or ovoid and free, with cloacal cavity, but *no* mouth, that is Häckel's "Auloplegma"-form. Texture delicate. Colour of the former pinkish brown (?derived from having been in proximity with a similarly coloured sponge); that of the other specimens whitish grey. Surface even, uniformly presenting a ridged *quasi* fibro-reticulated structure whose interstices are more or less triangular, owing to the sigmoid flexure of the ridges, which thus resemble a "plaited frill." Pores in the ridges. Vents of two sizes, viz. small and large: 1, small, numerous, situated in the bends or interstices of the sigmoid ridges, about 1-96th in. in diameter; 2, large, about 1-48th in. in diameter, scantily and irregularly scattered over the surface; both on a level with it, and both irregular in their outline, which is unmarginated, and all leading into the intervals between the *echinated* tubulation, which intervals are shut off from the cloaca by the lining membrane of the latter, as will be more particularly mentioned hereafter. This applies to all the forms, both open and closed, while in the "open" there is, of course, the addition of the vent or mouth to the cloaca, which is smooth and naked, and the cloaca in all presents a blistered-like surface, rendered uneven by a great number of infundibular depressions irregularly scattered over it; echinated throughout with the fourth ray of radiate spicules, and in direct communication at the bottoms of the "infundibular depressions" with the *echinated* tubulation of the general structure; also here and there with the "intervals" between this tubulation, by a few subsidiary apertures, which thus appear to be more accidental than general. Structure massive, tubular; tubulation subcircular, averaging 1-48th to 1-72nd in. in diameter, composed of a *single* layer of radiate spicules held together by sarcode, supporting the other soft parts, extending almost directly, that is being scantily branched, from the cloaca to the surface, leaving the "intervals" before mentioned between, which are very irregular in form, and for the most part much wider. Tubes *denseely and strikingly* echinated with the fourth ray of quadriradiates, whose curve is directed *inwards*; while the other rays, imbedded in the sarcode, go to form the

wall of the tube, thus leaving the surface towards the "intervals" *smooth*, by which the "tube" and the "interval," by contrast, are sharply differentiated; tubes or tubulation, as before stated, in direct communication with the cloaca through its infundibular depressions, becoming more or less tortuous, branched, and anastomosing as they extend outwards towards the surface, where they become divided and sigmoidally plicated, ending in the *quasi* fibro-reticulate ridges, whose structure is pierced by the pores, as above noticed. "Intervals" smooth, more or less in communication with each other, so as to apparently form a general chamber, which is shut off from the cavity of the cloaca, except through the "subsidiary apertures" just mentioned, opening on the surface through the "small and large vents" already described. "Subsidiary apertures" in the cloaca on a level with its surface, *not* in the infundibular depressions, *not* echinated, but marginated by a thin rim of sarcode, irregular in shape, size, and position. Wall of the "tubes" plentifully pierced by pores between the arms of the radiates, and the same with the lining structure or membrane of the cloaca; in short, there seems to be no surface in which *they* are absent, on all occasions. Spicules of two kinds, viz. triradiate and quadriradiate. Triradiate of two forms, viz.:—1, large, equiarmed and equiangulated, with the arms bent downwards and outwards sigmoidally, all together, like a "three-legged stool," each arm about 29 by 6-6000ths in., and the summit of the tripod about 24-6000ths in. from the base; 2, simple, triradiate, equiarmed, equiangulated, arm about 25 by $2\frac{1}{2}$-6000ths in. in the average largest size; 3, quadriradiate, about the same size as the foregoing, with the addition of the fourth ray, which for the most part is long, curved, and varies in length under 30-6000ths in. The tripodal form of the triradiate is confined to the ridges on the surface, where it is rather sparse; the common form to the surface generally, and the quadriradiates to the tubulation and surface of the cloaca respectively. Size of the largest specimen possessing a mouth (for there are three or more in the collection) $2\frac{1}{4}$ in. high by a maximum of $1\frac{3}{4} \times 1$ in. horizontally; cloaca $\frac{3}{4}$ by $\frac{4}{8}$ in. horizontally; mouth $\frac{3}{4}$ by $\frac{3}{8}$ in., also horizontally. Auloplegma-form like a goose-egg, 3 in. in its longest diameter by a maximum of $2\frac{1}{2} \times 1\frac{3}{4}$ in. horizontally; cloaca $2\frac{1}{2}$ in. in its longest diameter, by $1\frac{1}{4} \times \frac{2}{8}$ in. horizontally; wall about $\frac{3}{4}$ in. thick.

Obs. The most striking part of this species is the tubular *echination*, with regard to which it may be observed that, if the current is to be indicated by the direction of the *curve* of the fourth ray of the quadriradiates, as in the cloaca of *Grantia*

ciliata, in which it is directed outwards, it should here be in the opposite direction, viz. towards the cloaca; while the reproductive elements, viz. large ova presenting the germinal vesicle, as will be more particularly described presently, are on the *inner* surface of the *echinated* tube; therefore the analogy here is not between the echinated tubes and the cloaca of *Grantia ciliata*, but between the echinated tubes and the radial chambers of the latter; while the "intervals" would be analogous to the intercameral spaces or "intercanal system" of Häckel.

It may also be observed that the spiculation would be identical with that of my *Leucetta clathrata* ('Annals,' 1883, vol. xi. p. 33, pl. i. figs. 13–17), which came from the south-west coast of Australia, but for the *presence* of the quadriradiate spicule, and the *comparatively* scanty presence of the tripod spicules on the ridges of the surface.

The Auloplegma-form is plentifully charged with ova filled with minute spherical granules, in the midst of which is the germinal vesicle &c. The ova are about 1-24th in. in diameter, the germinal vesicle about 1-1200th, and the germinal spot 1-6000th in. in diameter. There are also much smaller nucleated granuliferous cells about twice as large as the spongozoa, that is about 1-2000th in. in diameter. What may they be?

Besides this the specimen is abundantly infested by a minute oscillatorian filament in bacillform fragments of different lengths, very much resembling in form the *Trichodesmium Ehrenbergii* which colours the Red Sea.

4. *Clathrina tripodifera*, var. *gravida*.

Individualized. Small when compared with the foregoing specimens, to which it will be found to be closely allied. Triangular, compressed, contracted towards the base or point of attachment, expanded above, composed of tortuous, branching, anastomosing reticulate tubulation more or less interstitially separate. Colour sponge-brown when fresh, whitish yellow when dry. Surface uniformly even, retiform, consisting of the superficial part of the tubular reticulation of which the whole body is composed, rendered prominent and glistening by a great abundance of the tripod spicules. Pores in the wall of the tubulation throughout. Vent-like openings three or four in number, chiefly in the upper border, defined by simple circular apertures in the general tissue, *not* marginated, leading into cloacal cavities below, which consist of equally simple dilatations of the reticulate tubulation at this part. Structure generally consisting of a minute, tortuous, branching and anastomosing hollow thread

or tubulation, around the cloacal cavities just mentioned, which respectively descend, narrowing towards the base and widening upwards until they become contracted again towards the vent. Tube composed of a single layer of triradiate spicules *only*, held together by the sarcode and its accompanying soft parts, among which, in this instance, a number of ova are present, which, by their size and the presence of the germinal vesicle, indicate that they are near to segmentation; traversed plentifully by pores, and opening here and there by circular holes into the cloacal dilatations, which is probably the case throughout the interstices of the reticulation generally; both the tubulation and the interstices varying greatly in diameter under 1-100th in., largest on the surface of the cloaciform dilatation, smallest towards the circumference. Spicules of *one kind only*, viz. triradiate, but of *two* distinct forms, as in the foregoing, viz.:—1, tripod-like, stout, with the arms bent downwards and outwards sigmoidally, about 20-6000ths in. high, spreading to about 20-6000ths at the base, arms about 21 by 6-6000ths in their greatest dimensions respectively; 2, the common form of triradiate, but much thinner than the foregoing, with arms more or less equal and more or less equiangled, varying in measurement under 20 by 1-6000th in. The former very abundant and almost entirely confined to the ridges formed by the reticulated tubulation *on the surface*, the latter to the interior. No quadriradiates. Size of specimen, which is compressed and nearly equilateral, $\frac{6}{12}$ in. high, upper border $\frac{1}{2}$ in. long, thickness of body $\frac{1}{8}$ in.

Obs. There can be no doubt that this is the same sponge as, only in a larger form than, that which I described and illustrated under the name of "*Leucetta clathrata*" ('Annals,' 1883, vol. xi. p. 33, pl. i. figs. 13–17); but we have here the tubular thread in a larger and distinctly *hollow* state, and not solid as assumed to have been the case in *Leucetta clathrata*, where, from contraction during desiccation, it had become solid, which, together with the smallness of the specimen, misled me into stating that it was "not hollow" (*op. cit.* p. 34), a mistake that I am thus able to have the opportunity of correcting, and of changing at the same time the name to *Clathrina tripodifera*, var. *gravida*, on account of the presence of the ova, above mentioned, which are in much the same condition as those in *Clathrina tripodifera*, whose description and dimensions have just been given. Hence the necessity of extended experience in laying down specifically the typical form of a sponge.

Of course, here we have the same structure as in *Clathrina*

tripodifera, but the tubulation, instead of being echinated and closed in, is without echination and separate; still, our "intervals," which in *C. tripodifera* we have considered to be analogous to Häckel's "Intercanal System," are here simply open vacuities. Not considering these differences sufficient to constitute a distinct species, it has been designated as a variety of *C. tripodifera*.

Hitherto the *structure* has not presented any indications of that cancellous kind which we have called "parenchyma," although there has been a more or less distinct cloaca and general vent, especially in *Clathrina tripodifera*, that is there is no additional structure of this kind to be seen outside or inside the wall of the tubulation; but now we come to a structure in which there is a faint trace of this parenchyma in the angles of union of the lamina of which it is composed, as will be described in the following species.

5. *Clathrina laminoclathrata* (dry).

Specimen a subcircular patch about $\frac{3}{4}$ in. in diameter and $\frac{1}{12}$ in. thick, which has grown over a rocky substance. Clathrous, massive, sessile, spreading, lamino-reticulate. Colour now (that is in its dry state) steel-grey. Surface even, smooth, reticulated by the clathrous holing of the structure generally, which here makes its appearance in the form of circular interstices of different sizes up to $\frac{1}{24}$ in. in diameter. Pores in the lamina. No appearance of a vent or vents of any kind, *i. e.* spurious or real. Structure lamino-clathrous; lamina solid, composed of a thin layer of radiate spicules supporting the sarcode and other soft parts. Spicules of one form only, viz. triradiate, equiarmed and equiangled, varying in size under 75-6000ths in. in diameter, ray alone about 45 by 5-6000ths in. Size above given.

Obs. In this instance, which is unique among the calcareous sponges so far as I know, the tubulated staple thread of *Clathrina*, which so generally characterizes this genus, is replaced by a flat, solid, "tape-like" form or staple, whose edge when cut presents no appearance of mesodermal structure or parenchyma whatever, although towards the angles of union, where of course the lamina branches off to form the clathrous structure of the mass, there is a small angular space left which bears a faint trace of parenchyma, and this seems to introduce us to what in this way will become so much more evident hereafter. It is represented among the non-calcareous sponges by "*Echinoclathria favus*" ('Annals,' 1885, vol. xvi. p. 292).

In the next species that will be described, viz. *Clathrina primordialis*, the reticulated flat lamina of *C. laminoclathrata* appears to be replaced by a vermiculated *tube*, in which the walls are just as thin as the lamina of this species, but which tubulation by repeated branching, contortion, and anastomosis, all more or less in apposition, assumes the form of a solid mass of this kind of structure in which the intervals between the tubulation afford a much larger space for parenchymatous structure than in *C. laminoclathrata*; in short, wherein the quantity of parenchymatous structure is much greater.

6. *Clathrina primordialis.*

(See *Ascetta primordialis*, H. *op. cit.* Atlas, Taf. ii. fig. 13.)

A massive, shapeless, sessile, sublobate, smooth, solid lump, attached by a plurality of portions of the body elongated into podal points below, whose interspaces extend upwards in an irregularly excavated manner towards the surface, where the lobes of the mass terminate in thick, irregularly interuniting, round, submeandering ridges, with intervening depressions, some of which extend down to the interspaces between the points of attachment; ridges on a level with each other, forming the crown of the mass. Texture delicate, light as cork when dry. Colour when fresh not given, probably whitish, as in one of the specimens, but now more or less pinkish brown, probably, as before stated of *Clathrina tripodifera*, from having been in the proximity of a similarly coloured sponge. Surface minutely ridged, *quasi* fibro-reticulately, with more or less lozenge-shaped interstices, smooth, even, covered throughout with an epithelial layer of cells more or less transfixed by the rays of subjacent spicules. Pores *in* the *quasi* fibrous ridges. Vents of two sizes, viz. small and large, both *un*marginated and on a level with the surface, viz.:—1, smaller, circular, numerous, in the interstices of the fibro-reticulated ridges, averaging 1-48th in. in diameter, and about the same distance apart; 2, larger, also circular, but flabby and comparatively scanty, scattered irregularly among the rest, chiefly over the projecting portions of the crown. Structure tortuously tubular, the tubes composed of a single layer of triradiates, held together by sarcode, averaging about 1-72nd of an inch in diameter, but very irregular in their calibre, branched, anastomosing, and in juxtaposition but for the presence of a narrow strip of *parenchymatous* tissue, which here and there becomes widened out into angular spaces, where the circular walls of the tubulation fail to come in contact with each other. Angular

spaces differentiated from the cavities of the tubulation by the presence of reproductive bodies and sarcode, which, especially in the dried state, presents a sponge-brown colour, while the surface of the tubulation is white and without this; so the two are easily distinguished. The parenchymatous part terminates externally in the thin *quasi* fibro-reticulate ridges of the surface, where, as before stated, it is traversed by the pores; but what its connexions internally are I have not been able to determine, although, from analogy, one would be inclined to conjecture that it opened generally by pores and here and there by small holes (the latter probably for the exit of the reproductive bodies) into the cavity of the tubulation. On the other hand, the tubulation opens on the surface through the small and large vents, that is the former directly and the latter after having come from more dilated portions in the centre of the mass; but all appear to be more or less in communication. Spicules of one form only, viz. triradiate, equiarmed, equiangulated; ray about 35 by 3-6000ths, varying in size under this with a few a little larger; densely charging the sarcode throughout, but especially on the surface, which is thus rendered a little more compact than the interior, so as in some specimens to present a cortical structure. Size of largest specimen, of which there are several, about 4 inches in diameter each way, being cubical.

Obs. In this species we cannot help seeing that the parenchymatous structure which intervenes between the contorted tubulation presents a still further step than in *Clathrina laminoclathrata* towards that which reaches its maximum in the Leucones and Teichonellidæ, as will be seen hereafter; at the same time that the dilated portions of the tubulation in the midst of the mass, in communication more particularly with the large vents externally, appear in the aggregate to be tantamount to a single cloacal cavity with general osculum; while the spaces occupied by the parenchyma appear to be the seat of Häckel's "intercanal system," that is, the interspaces between the "radial chambers" in *Grantia ciliata* &c.

In the large specimen of this species, viz. that described, there are also *ova*, but apparently scanty and in a more advanced stage, mixed up with minute crustaceans, which would hardly be there if it were not for the presence of the sponge-ova, for it is at this time that they more particularly invade most destructively the calcareous sponges; hence it is not improbable that some of the ova may be theirs, which prevents my being able to say what the sponge-ova are like. But there is another body also scantily present which is quite new to me, but, being more plentiful in the following species,

viz. *Clathrina ventricosa*, it will be more particularly described there. At first I thought this was a fungoid spore with long tubular tail-like appendage; but its much larger size, absence of septa, and the refractive granules of the interior issuing through the tail seem to be opposed to such a view.

7. *Clathrina ventricosa.*

Individualized. Massive, lobate, sessile generally, or attached by a plurality of attenuated portions of the body, thus resting on such points, or not attached at all, but free and floating, furnished with a large cloaca and contracted mouth, or the same in a group with wide crateriform mouths. Colour white or pinkish brown, the latter probably owing to the proximity of a red-coloured sponge. Texture comparatively firm. Surface-structure consisting of a thick cortex of radiates covered with deep, polygonal, infundibuliform depressions or holes echinated round the inner ends and often diaphragmed there by cribriform sarcode; built up of large radiates, whose intercrossing rays give the polygonal form; almost in juxtaposition, and varying in size under 1-20th in. in diameter; or with the same reduced, probably by friction, to a white, homogeneous-looking, compact, cortical layer, in which the same kind of holes are present, but without the polygonal infundibular form, being simply subcircular and more or less variable in size. Pores in the intervals between the "infundibular depressions." Vents of two kinds, viz. small and numerous and large and single; the former, that is the small kind, at the bottoms of the "infundibular depressions" respectively, varying in size with that of the depressions themselves, echinated &c. at the inner end, as just stated; the latter large and single, bordered by a thin lip of fine structure about 1-16th inch wide; both leading to a large cloaca, whose surface is thickly beset with holes of two kinds, viz. one situated at the bottom of deep, broad, conical depressions, which vary in size, depth, and distance apart, and the other for the most part small, circular, and on the surface; both also communicating with the "hollow spaces" in the general structure of the wall, which will be more particularly mentioned presently; surface of the cloaca pierced generally with pores and sparsely echinated; echinating rays most abundant round the holes leading into the hollow spaces of the wall. Structure of the wall, which in some of the large specimens exceeds an inch in thickness, composed of vermiculated tissue, consisting of tortuously branched and anastomosing tubulation, which may be divided into two kinds, viz. that which is more

particularly defined by a cortex and *filled* with parenchymatous structure, and that which is *empty* or hollow, to which I have just alluded; the former in communication with the surface, the cloaca, and the hollow spaces by *pores* situated in these parts respectively, together with small holes, but much larger than the pores, in the cortex here and there, also opening into the hollow spaces. Hollow spaces or intervals communicating externally through the infundibular holes of the surface and internally with the cloaca through the holes in the surface of this cavity. Structure of the parenchyma cancellous, traversed by branched canal-systems which respectively open into the hollow spaces through the "small holes" in the cortex just mentioned; canals more or less echinated by the fourth ray of quadriradiates. Hollow spaces more or less smooth or sparsely echinated, like the cloaca. Spicules of two kinds, viz. triradiate and quadriradiate, both apparently equally abundant:—1, triradiate of two sizes, viz. large and small, the former equiradiate and equiangled, a little raised in the centre; rays stout, irregular in their outline, becoming suddenly much diminished a little way from the end, about 52 by 13-6000ths in their greatest dimensions; the latter or smaller similar, but with the ray more regular in form, about 35 by 4-6000ths; both forms variable in size between the measurements given. 2, quadriradiate, the same as the smaller triradiate in size, but with the fourth ray in addition curved and somewhat shorter. The large triradiates appear to be confined to the surface, where they are occasionally provided with a fourth arm, and the quadriradiates, mixed with the triradiates, to the interior generally, the former perhaps most abounding on those surfaces which are most echinated. Size varying with that of the specimen, of which there are upwards of a dozen, extending from that of a small bean to one nearly 6 inches in its longest diameter. The largest of all is the free or floating specimen, which is subovoid, 3 inches high, that is placing the large mouth upwards (for there are several small ones about the body, each provided with a lip), and $5\frac{3}{4} \times 4\frac{5}{8}$ horizontally in its greatest diameters; the large mouth is 3 by $\frac{1}{2}$ inch in its greatest diameters, and the cloacal cavity much larger; wall averaging an inch thick. The rounded form combined with a compact, white, even, homogeneous-looking structure on the surface indicates that this specimen has for some time been free and floating; its parenchyma is abundantly charged with reproductive bodies. The next largest specimen was attached by several attenuated portions of the body, and, having been much less exposed to friction, presents a much more perfect state of the

surface. In form this specimen is more globular, being about 4 inches high by $\frac{3}{4}$ in diameter, but consisting of two individuals joined together, has two large subcircular vents, each about an inch in diameter, leading to two cloacæ below of much larger dimensions; while the specimen with crateriform vents, each of which is an inch in diameter, leading into cloacæ a little deeper, consists of a group of several such individuals joined together and sessile generally.

Obs. This is by far the largest and most abundant in specimens of all Mr. Wilson's calcareous sponges, and it is somewhat remarkable that, like the floating Auloplegma-form of *Clathrina tripodifera*, it should be abundantly charged with reproductive bodies. But for the asconoid or tubular structure of this species, the amount of parenchyma is so great that it closely resembles Häckel's *Leucaltis floridana* in this respect (*op. cit.* Taf. xxvi.); and in some specimens the canals and spaces in the parenchymatous structure are so thickly echinated by the fourth ray of the quadriradiates that, on the other hand, they look like the echinated tubes of *Clathrina tripodifera*, while here, as in the latter, they are easily distinguished, especially in the sections of the dried portions, by their *yellow side*, owing to the presence of the dried sarcode and its contents lining in particular this part, while that of the "hollow spaces" is smooth and more or less white. Are the "hollow spaces" here analogous to the "intervals" in *Clathrina tripodifera*, which in the latter have been shown to be identical with Häckel's "intercanal system;" while here they are apparently as evidently analogous to the "radial chambers" of *Grantia ciliata* &c., through which they may be homologized with the excretory canal-system in *Teichonella prolifera*? I must leave others to make the adjustment.

In some of the specimens which are altogether solid the small infundibular vents on the surface are supplemented by several larger ones, which, not leading to a *single* large cloaca, are in this respect like those of *Clathrina primordialis*, that is, connected with several dilated portions in the midst of the structure internally, which in the aggregate amount to a large single cloaca; but they differ from those in *Clathrina primordialis* in being all provided with a *lip*.

The large "free and floating" specimen of this species is plentifully charged with ova about 1-333rd in. in diameter, from which the germinal vesicle has in most instances disappeared, and in some of which the first line of segmentation seems to be visible. But the body to which I have just alluded as being scanty in *Clathrina primordialis* is here as

abundant as the ova, if not more so. It is a long elliptical cell, more or less slightly curved and more or less round at the free end, which sometimes appears to be flattened for a minute distance and sometimes doubly papillated, but the latter very indistinctly, and therefore not satisfactorily determinable; this at the other end opens widely into a long caudal tubular appendage, which becomes somewhat contracted in the middle, to expand again into a suctorial or trumpet-shaped form at its free extremity. In size the total length is about 33-6000ths inch, of which 12 × 6-6000ths go to the cell or head and 21-6000ths to the tail, which is about 1-6000th in. in diameter at the extremity. The cell presents a large refractive nucleus at the free end, and the rest is filled with equally refractive spherical granules of about half the size of the nucleus, which can be traced as they issue through the tail, and sometimes form a heap at the end, where they have exuded. What this body is I am unable to conceive, unless it is a parasite which, like the minute Crustacea, infests the specimen.

Besides the large ova and these bodies &c. there are also small cells from 3 to 6-6000ths in. in diameter, sometimes nucleated, but always filled with spherical refractive granules like those of the yelk in the ova. Are these the spermatozoid cysts or cells? They, like the ova, are mixed up with the spongozoa, which are only about $1\frac{1}{2}$-6000th or 1-4000th in. in diameter—measurements which could not have been made here or in the other instances had not the greater part of these sponges been, as they still remain, in an excellent state of preservation for this purpose.

8. *Clathrina latitubulata* (provisional, incertæ sedis).

Agglomerated. Composed of a comparatively large, more or less contorted and anastomosing tube about $\frac{1}{8}$ in. in diameter, swollen or dilated at short distances into rounded forms, which give it an irregularly knotted appearance, on each of which knots or prominent parts there is a single vent or none at all. Colour sponge-brown when fresh, whitish outside when dry. Surface even, composed of large radiate spicules interunited by more or less defined areas of cribriform sarcode. Pores large, represented by the cribrate areas. Vents single, naked, on the prominent parts of the lobes or dilated portions. Structure consisting of a very thin wall, most of which is cortex or surface-structure, not averaging more than $\frac{1}{16}$ in. in thickness, composed of two or more layers of large and small radiates, held together by the sarcode of the

surface, but more particularly by a comparatively thick layer of the same substance internally; continuous over one part and cribrated with large holes in another, opposite to corresponding holes in the cortex, rendered more or less polygonal by the intercrossing of the arms of the large radiates, and through which the cribriform areas of the surface can be seen. Spicules of two kinds, viz. triradiate and quadriradiate:—1, triradiates of different sizes, mostly regular in form and mostly large; ray 90 by 15-6000ths: 2, quadriradiates of two sizes, viz. very minute and very large; the former numerous, sagittal in shape, averaging only 10 by 1-6000th in the shaft, with arms respectively about half this length, and the latter, which tends more to a regular form and is scant, with arms 150 by 21-6000ths. No. 1 is chiefly confined to the cortex, the minute form of no. 2 to the sarcodic lining of the interior, with the large form here and there in the interior of the cortex. Size of specimen, which altogether is irregularly oblong, about $1\frac{1}{4} \times \frac{3}{4} \times \frac{1}{2}$ inch.

Obs. The structure of this species, if not abnormal, is very uncommon, on account of the general form in combination with such a thin wall; not less so the layer of sarcode over the inner surface, which is charged with the minute quadriradiates confusedly distributed throughout its substance, hence indicative of an abnormal condition. In general form, that is in outward appearance, it is very much like Polèjaeff's *Heteropegma nodus gordii* ('Challenger' Reports, 1883, Calcarea, p. 45, pl. i. fig. 7, and pl. iv. fig. 1), which also came from Australia, viz. from off "Cape York" at the N.E. angle, since that from the Bermudas appears to have been too much injured for illustration, but when anatomically examined proves to be totally different, as may be seen by the descriptions respectively.

[To be continued.]

XLVIII.—*On a Species of* Echinocardium *from the Channel Islands.* By F. Jeffrey Bell, M.A.

Some weeks ago I received from Mr. Finlay of the Watt Museum at Greenock, an exceedingly fine specimen of *Echinocardium*, which he asked me to determine for that institution. A very superficial examination of the object showed me that it was altogether unlike any specimen in the British Museum, and that it could not be readily assigned to any described

species. As the specimen which belongs to the Greenock Museum had been purchased of Messrs. Sinel and Co., of Jersey, I entered into communication with those gentlemen, from whom I had already received valuable specimens of worms, and was able to obtain a specimen of *Echinocardium* covered with spines, and, at first, recalling *E. flavescens*; still later Messrs. Sinel have sent me a third specimen devoid of spines, which is larger than the others and deserves description.

No anterior ambulacral groove; test irregularly cordiform, at its widest the measurement is nearly as great as the length; anterior lateral ambulacra with eight and fifteen pores, the posterior with fourteen and twelve. Anus a little overhung by posterior interambulacrum; the granules in the anterior ambulacrum larger and much less closely packed than elsewhere on the dorsal surface of the disk.

Greatest length 74 millim., greatest width 71 millim.

A comparison of this description with that given by Mr. L. Barrett of what, with doubt, he calls *Amphidotus gibbosus*, Agass., shows that the specimens agreed in so far that his was as broad as long, had eight and fourteen pairs of pores in the anterior lateral ambulacrum, had the anus depressed, and the anterior ambulacrum flush with the surface of the test.

If the "Greenock" and our specimen be of the same species as Barrett's example, there is a further agreement in the thick coating with curved spines, and the spines of the post-oral space having slightly flattened tips.

On the whole I should be inclined to think that the three specimens now before me were of the same species as that seen by Mr. Barrett, were it not for the following considerations:—Mr. Alder and the Rev. Canon Norman agree in thinking that the specimen assigned by Barrett to Agassiz's species agrees rather with the *Echinocardium pennatifidum* of Dr. Norman; but this last has peculiar pedicellariæ of which I can find no trace, has but four pairs of pores in the anterior of the antero-lateral rows of ambulacral pores, and is not nearly so broad as long, having a greatest length of 60 and a greatest breadth of 50 millim.

The examination which I have been able to make of *Echinocardium cordatum* and *E. flavescens* have shown me that there is a considerable area of variability within this genus; but I cannot determine its range for *E. pennatifidum* or this apparently different species without material far larger than that which has already come to my hands. I shall be glad of any assistance which my fellow naturalists or those who are interested in British zoology are able to give me.

Zoological Department, British Museum.

XLIX.—*On a new Genus of Devonian Corals, with Descriptions of some Species of the same.* By H. ALLEYNE NICHOLSON, M.D., D.Sc., Regius Professor of Natural History in the University of Aberdeen; and ARTHUR H. FOORD, F.G.S., late of the Geological Survey of Canada.

[Plate XVII.]

[Continued from p. 400.]

Rhaphidopora stromatoporoides (continued).

We are, however, entirely satisfied that the appearances just described, upon which Schlüter founded his *Pachytheca stellimicans*, are of purely inorganic origin, and are the result of mineralization. They are probably due to a finely fibrous crystallization of the calcite, which has caused the dark-coloured impurities in the matrix to arrange themselves in conformity with the crystalline fibres. The radiating fibres thus produced frequently extend from one tube to another, cutting through the walls of the corallites, and so producing the beautiful starry appearance which characterizes tangential sections, and upon which Prof. Schlüter based his name of "*stellimicans*"*. This process of mineralization was potent enough to effect the almost complete destruction of the tabulæ, and in large part that of the walls of the corallites as well, the latter remaining in parts only obscurely discernible. Here and there this process was not quite complete, and hence we sometimes find spots in most vertical sections (Pl. XVI. figs. 1 *c* and 7) in which the visceral chambers have not been wholly occupied by this infiltrated material, but have been partially filled with clear calcite, and have the tabulæ still left. Moreover, by the extension of the radiating crystalline fibres from each centre of crystallization through the walls of the corallites into contiguous tubes were produced those curious dark transverse bars seen in tangential sections intersecting the walls of the tubes, and regarded by Prof. Schlüter as of the nature of filled-up mural pores.

That the remarkable structure here in question is the result of some such process of infiltration and crystallization as above sketched out is rendered certain by the examination of a suffi-

* A somewhat similar appearance is presented in tangential sections of *Monotrypa quadrata*, Rominger, a Monticuliporoid from the Cincinnati group (Caradoc) of Cincinnati, Ohio. In this we find the visceral cavities of the corallites traversed by irregular lines, which radiate from each angle of the cell-wall and meet in the centre (see woodcut). The same phenomenon is met with also in some other palæozoic corals.

ciently large series of thin sections, since we then find all possible gradations to exist between the specimens of the first group ("*piliformis*" group) and those of the second ("*stellimicans*" group). Indeed, a single slide will sometimes exhibit almost all the transitional stages which conduct us from the one group to the other. Thus we find certain specimens in which the corallites, either throughout the entire corallum or merely here and there, have their visceral chambers quite free from the darker material. Even in such specimens (Pl. XV. figs. 5, 6, and also woodcut, fig. A) we find, however, that the walls are not uncommonly slightly thick-

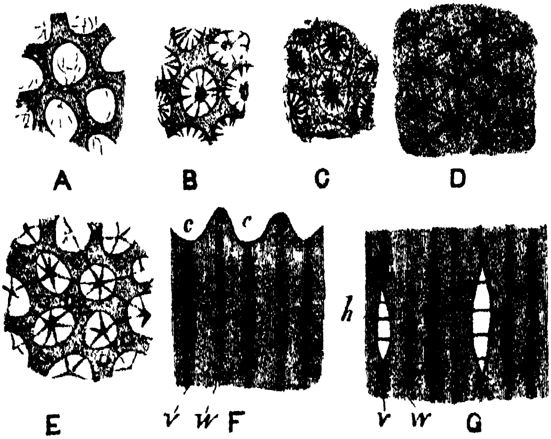


Fig. A. A few cells from a slide of *R. stromatoporoides*, Roem., taken from a part where the visceral chambers of the corallites are filled only with clear crystalline calcite, and the walls are only slightly altered. Fig. B. A few cells from another part of the same slide, in which the radiating crystalline structure is incompletely developed, the walls of the corallites being still discernible and the visceral chambers partly unaffected (filled with matrix). Fig. C. A few cells from another part of the same slide, in which the walls are still to be seen, but the crystallization has assumed its characteristic stellate form. Fig. D. Another part of the same slide, in which the walls of the tubes have become completely obliterated, and we see only the dark stars, the centres of these corresponding with the centres of the visceral chambers. Fig. E. A few cells from a slide of another specimen, in which the walls are left, and the rays of the crystalline stars are seen cutting through the walls, and thus uniting with contiguous stars. Fig. F. Part of a vertical section of the same, completely crystallized; and fig. G. Another vertical section incompletely infiltrated: *v*, dark lines representing the axes of the visceral chambers: *w*, faint vertical lines, representing the walls of the corallites; *h*, portions of the visceral chambers infiltrated only with clear calcite, and still showing tabulæ; *c*, calices. All the figures are enlarged twenty-four times.

ened, while a more or less conspicuous crystalline structure of the wall is almost always developed. This crystalline structure is shown in two ways. In the first place, the walls of the corallites, as seen in either horizontal or vertical sections, exhibit dark and light patches, often angular, and sometimes very regularly disposed (Pl. XV. fig. 7 *a*, and Pl. XVII. fig. 3), the cause of this being clearly the different orientation of the calcite crystals traversed by the plane of the section. In the second place, contiguous visceral cavities are seen in transverse sections to be united by dark lines or bars which run transversely across the walls and are sometimes very regular in their arrangement (Pl. XVII. fig. 3). These bars are the beginning of the radiate crystallization which ultimately gives rise to the "*stellimicans*" structure.

In other specimens, again, or in particular parts of a specimen, we find the radiating crystalline structure further developed, a zone of radiating crystalline fibres now lining each corallite, but the walls of the corallites still remaining visible (woodcut, fig. B). This lining may be so thick as to leave open only a small central space in each corallite (Pl. XVI. fig. 5), or it may extend quite to the centre of the corallites, in which case each tube is filled with a more or less marked crystalline stellate mass (Pl. XVI. fig. 3, and woodcut, fig. E).

The next stage is the more or less complete obliteration of the walls of the corallites. This sometimes takes place while the central portion of the visceral chamber is yet uninfiltrated (Pl. XVI. fig. 2 *a*). More commonly the obliteration of the walls is accompanied by the complete infiltration of the corallites, in which case there is developed the typical "*stellimicans*" structure previously described (Pl. XVI. fig. 2, and woodcut, fig. D).

Vertical sections show much the same differences in the extent of the infiltration and subsequent crystallization by which they have been affected; but the walls are usually less easily recognizable in these than in transverse sections (Pl. XVI. fig. 1 *c*, and part of figs. 4 and 6; Pl. XVII. fig. 4). It is usually the case also that the tabulæ have been completely obliterated; but in most sections we may find here and there smaller or larger portions of the visceral cavity—always occupying the centre of the cavity—to which the infiltrating material, owing to some local cause, has not penetrated, and in which we meet with transparent calcite intersected by the remnants of the tabulæ (Pl. XVI. figs. 1 *c* and 7, Pl. XVII. fig. 4, and woodcut, fig. G). This fact, among others, would show that the stellate crystallization has struck inwards from the walls towards the centre of the tubes, and not *vice versâ*.

The only other point in connexion with this singular crystalline structure with regard to which a few words may be said is as to whether or not a similar structure is ever developed in *R. crinalis* as well as in *R. stromatoporoides.* Considering that these two species are very closely allied and that they commonly occur in association, we should expect that such a purely inorganic change as that which induces the "*stellimicans*" condition would equally affect both these forms. As a matter of fact we think it probable that of the many specimens in the "*stellimicans*" state which we have examined some are really referable to *R. crinalis*, Schlüt., and not to *R. stromatoporoides*, Roem. As, however, the induction of this condition more or less extensively obliterates the normal structures of the coral, we are not prepared to assert this positively. We do meet, however, with "*stellimicans*" specimens in which the tubes are decidedly larger than they are in the majority of examples (see Pl. XVII. fig. 1), and it is not improbable that these represent examples of *R. crinalis* which have undergone this peculiar process of mineralization. We have, moreover, a specimen from the Devonian rocks of Devonshire consisting of two superposed colonies which presumably belong to a single species, and of which one colony is in its normal state, while the other is in the extreme form of the "*stellimicans*" condition. The unaltered colony (Pl. XVII. fig. 6) is undoubtedly *R. crinalis*, and the "*stellimicans*" colony (Pl. XVII. fig. 5) is *probably* the same, though its tubes are certainly not so large as those of its fellow.

Finally, we cannot pass over without remark the singular tubercles which are commonly developed in *R. stromatoporoides* at the angles of junction of the corallites (Pl. XVI. figs. 1 *a*, 3, and 5). These structures are something like the "acanthopores" of the Monticuliporoids, but are undoubtedly of a different nature. They are best seen in specimens in the "*stellimicans*" condition, when the walls are not completely destroyed; but there are indications of their presence in even normal examples of the species. We are inclined to think, however, that they are merely the result of mineralization affecting in some peculiar way the thickened angles of junction of the tubes.

Formation and Locality. Abundant in the Middle Devonian of Gerolstein, in the Eifel, where it occurs in all its forms. Rare in the Middle Devonian of Teignmouth, Devonshire.

Rhaphidopora ? sp. (Pl. XVII. figs. 7–10.)

We have seen that both *R. crinalis*, Schlüt., and *R. stromatoporoides*, Roem., occur in the Devonian rocks of Devonshire. We have here figured slides of two other examples of *Rhaphidopora* which we have from the same formation and which we are unable to identify with certainty. One of these (Pl. XVII. figs. 7 and 8) exhibits rounded thick-walled tubes, intersected by complete horizontal tabulæ, but apparently without septal spines. The diameter of the tubes is on an average about a third of a millimetre. The specimen from which these slides were taken was collected by Mr. Champernowne in the Middle Devonian Limestone of Dartington, and forms a mass of considerable size. The specimen is highly mineralized, and the absence of the septal spines may be due to this. It is not improbable, therefore, that this is only an altered example of *R. crinalis*, Schlüt.

The other specimen to which we refer (Pl. XVII. figs. 9 and 10) is from Teignmouth, and agrees with the preceding in the general dimensions of its tubes and the apparent absence of septal spines. Its distinguishing feature is the angularity of the corallites and their comparatively irregular shape. This specimen also is much mineralized and does not admit of positive specific characterization; it cannot even be stated with certainty to belong to the genus *Rhaphidopora* at all.

EXPLANATION OF PLATE XVII.

Fig. 1. Part of the vertical section of a double colony of *R. crinalis*, Schlut. (?), enlarged twelve times, in which one colony is normal and the other is in the "*stellimicans*" state. This may be only an example of *R. stromatoporoides*, Roem., with unusually large tubes. Middle Devonian, Gerolstein.

Fig. 2. Part of a tangential section of *R. stromatoporoides*, Roem., in the "*stellimicans*" state, enlarged twenty times. The tubes are below the average size. Middle Devonian, Gerolstein.

Fig. 3. Part of a tangential section of *R. stromatoporoides*, Roem., enlarged twenty-four times. The walls of the corallites are highly crystallized, and are completely fused with their crystalline lining, no longer appearing as distinct structures in the portion of the section figured. The centres of the visceral cavities are still unobliterated, and they are joined by regular radiating lines, the result of stellate crystallization. Middle Devonian, Gerolstein.

Fig 4. Vertical section of a specimen of *R. stromatoporoides*, Roem., which is wholly in the "*stellimicans*" state. It consists of several superposed colonies, of which the lowest has tubes of much larger size than the others, and *may* belong to *R. crinalis*, Schlüt. Enlarged twelve times. Middle Devonian, Gerolstein.

Fig. 5. Tangential section of a specimen of *R. crinalis*, Schlüt (?), enlarged twelve times, from the Middle Devonian of Teignmouth. The specimen consists of two superposed layers or colonies, of which one is in the "*stellimicans*" state, while the other is normal. The former is here figured.
Fig. 6. Vertical section of the normal layer of the specimen just referred to. The tubes in this layer are larger than those in the layer represented in fig. 5, and certainly belong to *R. crinalis*, Schlut.
Fig. 7. Tangential section of *Rhaphidopora crinalis*, Schlut. (?), from the Middle Devonian of Dartington (coll. A. Champernowne), enlarged twelve times.
Fig. 8. Vertical section of the same, similarly enlarged.
Fig. 9. Tangential section of *Rhaphidopora* (?) sp., from the Middle Devonian of Teignmouth, enlarged twelve times.
Fig. 10. Vertical section of the same, similarly enlarged.

L.—*Additional Remarks on the External Aspect of the Tunny.* By Prof. W. C. M'Intosh, M.D., LL.D., F.R.S., &c.

The head and some other parts of the specimen of *Orcynus thynnus* mentioned in the 'Annals' for April were reserved for a subsequent communication, and hence no special allusion was made to the teeth. These of course occur on the vomer, in which respect, as my friend Mr. Day (whose valuable and long-continued labours amongst the fishes of our own and foreign countries would alone command respect) says, it differs from such as the bonito (*Thynnus pelamys*), a very good example of which was caught near St. Andrews, and is now, thanks to Dr. J. Moir, in the University Museum. Mr. Day's drawing of the teeth was not specially alluded to otherwise than by the general statement that "the teeth are somewhat fancifully represented in all the figures." The facts are that in his plate about eighteen or twenty teeth occur in a lateral view along the premaxillæ and maxillæ, and about fourteen or fifteen in the mandible. In the adult male about fifty occur in each of the series above mentioned. A similar criticism applies to his illustration of the dentition of the bonito. I know it is very difficult to give an adequate representation of such a range of small teeth in a figure of the size of Mr. Day's, and only allude to this to indicate that accuracy was the sole aim of my remarks.

In regard to the dorsal spines* there is a decided divergence between the figure in Day's 'British and Irish Fishes' and the example at St. Andrews, since the first spine is much

* These are thirteen in number.

more powerful—broader at the base and hence more rapidly tapered. Unfortunately Mr. Day does not state (and this is important) whether his figure is taken from a small or a large example, since the relative proportions between the length of the spines and the depth of the body probably undergo changes during growth. The first spine is one which even the uninitiated would call powerful. Another way of looking at the comparative lengths of the spine and other parts than that adopted by Mr. Day is to measure it (the spine) accurately by compasses in the figure in the 'British and Irish Fishes,' and then pass the compasses downward over the body, when it is found that at the second sweep of the instrument the free tip slightly exceeds the ventral outline. In the fresh example here nearly three such steps were necessary to clear the ventral margin.

If the premaxillary and maxillary region in the recent animal be measured with calipers, and the instrument then be turned backward to the opercular margin, the observer will find that two steps require to be taken to reach the latter (opercular margin). If this be done in Mr. Day's figure it will be found that the second sweep of the compasses exceeds the opercular margin by about a fourth. The measurements in the case of the "snout" and the "eye" mentioned by Mr. Day give the results he states, though in his figure the distance exceeds $2\frac{2}{3}$ (that for the larger example in the British Museum). The eye in the figures is as stated in my paper when compared with the fresh example. Further, if a vertical line be drawn along the posterior margin of the operculum, it will be found to approach the first dorsal spine too closely in Day's figure, thus additionally demonstrating what was mentioned with regard to the head. A reference to Mr. Couch's figure will also clear up the situation on this point, as well as bring out the fact that the origin of the pectoral is considerably in advance of a vertical line from the first dorsal spine, instead of being touched by it, as in the 'British and Irish Fishes.' Couch, it is true, says in his description that the first dorsal begins nearly above the origin of the pectoral; but his figure more closely accords with nature in this respect.

The relative positions of the second dorsal and the anal fins may vary; but such cannot be allowed to rest on facts derived from stuffed specimens. If it were so, the novelty of the origin of one pectoral in front of the other could in the same manner be stated of the bonito in the St. Andrews University Museum. In the tunny so characteristically was the anal behind the vertical line from the posterior base of the second dorsal,

that in severing the trunk by a vertical incision for convenience in maceration the second dorsal fin remained on the anterior, the anal on the posterior moiety. If a reference be made to Couch's figure, this feature will be apparent at a glance; and the author had the advantage of familiarity with fresh specimens. The shape of the pectoral fin in Mr. Day's figure, as well as that of the anal, does not correspond with that in the fresh specimen; and as the pectoral in the stuffed bonito in the museum here agrees with the latter, it is probable that the taxidermist has dragged out the inner rays too prominently in the specimen figured.

No allusion has been made by Mr. Day in his rejoinder to the finlets, which deviate from nature in contour and character not only in his figure of the tunny, but likewise in the bonito; and since the character of these fins is apparently more or less uniform, perhaps the illustrations of the albacore and pelamid may also be included in the criticism. An isolated figure of one of these is given in the plate formerly alluded to *, and, moreover, they were carefully photographed when fresh. The taxidermist has had some trouble (or else the skin and its appendages must have been very pliant) to get these organs into the "taut" and wholly unnatural position represented in the figures criticised†. Considerable force could not accomplish this in the specimen at St. Andrews even after five month's partial maceration.

Mr. Day refers to the accidental placing of *bubalis* instead of *scorpius* opposite the title "The Short-spined *Cottus*," on p. 433 of the 'Annals' for June 1885. He is probably unaware that the "correction" he alludes to existed in print a month or two previous to June 1885, and was issued ‡ about the time the paper he notices was published; indeed the slip must have occurred when copying from the proof of the former. Moreover, in the paper in the 'Annals' the title (*C. scorpius*) occurs in the explanation of the plate.

The foregoing remarks will show that it is hazardous to rely on a stuffed animal unless special precautions, by photographs and otherwise, be taken in the preparation, and that plate xxxv. of Mr. Day's 'British and Irish Fishes' does not adequately represent nature.

* *Vide* Fourth Annual Report of the Fishery Board for Scotland.

† Subsequent desiccation may have increased the effect, though it has not done so in the bonito at St. Andrews.

‡ Third Report of the Fishery Board for Scotland, p. 59.

LI.—*On the British Weevers, the Bib, and the Poor-Cod.* By Francis Day, C.I.E., F.L.S., &c.

In last month's number of the 'Annals and Magazine of Natural History,' Prof. M'Intosh, Superintendent of the Marine Laboratory at St. Andrews, propounded the two following opinions: that it is possible the lesser and greater weevers (*Trachinus vipera* and *T. draco*) are only the young and adult stages of one species; also that the *Gadus minutus* is the young of the bib or *G. luscus*. As in that paper some of my views are discussed, I have thought that a short reply to the article may be desirable.

I do not propose entering into the history of these two forms, of which the greater weever, *Trachinus draco*, up to the time of Gmelin's 'Linnæus' (ed. 12), was considered a species, and the lesser weever was deemed the same fish or merely a variety, but which latter figured in Willughby, 1686, and Ray, 1713, as a distinct species, while Duhamel, in France, clearly laid down the reasons why it ought to be so looked upon. Since then every British and French author who has studied ichthyology has recorded both as species. Specimens of each have been found containing eggs; Couch was so fortunate as to possess a young one of *the larger form* only three quarters of an inch in length; while there are certain structural differences between *T. draco* and *T. vipera*; and I would suggest whether it is not possible that the better plan would have been to obtain the intermediate forms before giving publicity to the theory that one was the young of the other, and that without proof.

If we turn to the works of Cuvier and Valenciennes, Yarrell, Couch, Günther, Moreau, and my own, we find the fin-rays thus recorded:—*Trachinus draco*, or the greater weever: dorsal from 29 to 31 rays, anal from 30 to 34 rays; *T. vipera*, or the lesser weever: dorsal from 21 to 24 rays, anal from 24 to 26 rays. No intermediate numbers, so far as I am aware, have been enumerated from British specimens; and without such gradations (not the result of hybridization), or without showing sexual differences, I think it is unsafe to conclude that the larger form is merely the adult of the smaller species.

The difference in the absence of spines above the orbit in the smaller form and its greater depth "in proportion to its length "are given as distinctions which it is possible disappear with age." As the supraorbital spines are absent from the smaller specimen, but seen in the larger, it is somewhat unlikely, not impossible, that they first appear in the older fish; but the reverse is the general rule, spines about the head in the young Acanthopterygians becoming blunt or even

disappearing in the adult, as seen in *Serranus*, *Lutianus*, &c. I omit further reference to the great difference in the proportions of the depth of the body and length of the head in the two forms, as Dr. M'Intosh suggests such may be due to age. But can any fish in our waters closely allied to the weevers be pointed out wherein soft rays *invariably* increase in number with age or size of the specimen in both the dorsal and anal fins, forming a fair reason for supposing that such may be the case in the weevers?

As regards the larger fish being taken in deeper water, this of itself is no criterion as to specific difference. The eggs or very young fry of forms in which the ova float, as in the weever, as well as the larger examples of the fish, will most probably be found in deep water, as in other marine fishes; but I have personally seen the greater weever brought on shore in a seine-net and trawled by a shrimper.

Ogilvy asserts that the greater weever is not found in Ireland, where the lesser weever is not unfrequent, and several naturalists have believed that this latter form is more partial to the colder north than is the former. How Dr. M'Intosh can advance that "a perusal of Dr. Günther's accurate and careful remarks on the two forms above mentioned strengthens the views just expressed," I fail to perceive. Dr. Günther observed, "On the British coasts two species occur—*T. draco*, the greater weever, attaining to a length of 12 inches, and *T. vipera*, the lesser weever, which grows only to half that size" ('Introduction to the Study of Fishes,' p. 464).

Prof. M'Intosh (following Winther, 1879) considered "that what has been described as the poor- or power-cod (*Gadus minutus*) by several authors is only the young of the bib." Continuing that "a large series from various parts of the British seas leaves little doubt as to the identity of the two forms. It would appear that the confusion in regard to this species has partly arisen from an examination of preserved specimens."

Dr. Günther remarked of the bib, *G. luscus*, that "the ribs of this species are proportionately longer and stronger than in the" *G. minutus*, &c. Personally I should have liked to have examined more specimens; as it was, I compared examples of the two forms of the same length, and found that in the *G. minutus* the anal fin did not commence nearly so far forwards as in the bib, in which latter the vent was placed below the anterior portion of the first dorsal fin, whereas in the *G. minutus* it was much further back, being below its last rays. But if these variations are not persistent, and the two forms pass insensibly one into the other, the differences may be sexual or accidental, and a detailed account of the intermediate links would be desirable, until the appearance of which I will defer my further criticism.

LII.—*Notes on Synonymy of Australian Lepidoptera described by Mr. Rosenstock.* By E. MEYRICK, B.A., F.E.S.

IN the 'Annals and Magazine of Natural History' for 1885 (vol. xvi. pp. 376–385, 421–443) is a paper on Australian Lepidoptera by Mr. Rosenstock, which requires a good deal of correction in order to make it available for scientific use. It appeared to me therefore desirable to embody in a short note the principal alterations which require to be made in respect of the Geometrina and Microlepidoptera, to which most of my attention is given. I may add that, as Dr. Lucas (the collector of the insects described) has placed in my hands types of the greater number of his species, I am enabled in most cases to speak with confidence of the identification of those described by Mr. Rosenstock, of which the descriptions are not always sufficiently precise. Mr. Rosenstock expresses an opinion that I have overlooked descriptions of several species, and in some cases (only one is mentioned) described neuration wrongly; this is possible enough, but by reference to the notes hereafter following it will be seen that in every instance quoted he is mistaken.

Messatis, Walk., is stated to be distinct from *Endotricha*, but no points of difference are given; without these it is obvious that no attention can be paid to the assertion. The species (*E. pyrosalis*, Gn.) agrees with *Endotricha* in every character known to me, as I have elsewhere pointed out.

Scopula segestusalis, Walk., is, as admitted, too much worn for recognition, and was intentionally neglected. I should add that my paper on Australian Pyralidina did not profess to be exhaustive, and that several probably good species described by Walker were purposely omitted for want of specimens for examination.

Isopteryx nitidalis, Walk. Stated to be overlooked by me; it will be found in the genus *Musotima*, and has no connexion with *Isopteryx*.

Scoparia pusilla, Ros. I have not seen an authentic specimen, and cannot recognize this, but think it may probably be *S. spelæa*, Meyr.

The genus *Thalaina*, Walk., is placed (following Walker) among the Liparidæ; it belongs to the Boarmiadæ.

The species included in the genera *Fidonia*, *Panagra*, and *Dasyuris* have in no instance any connexion with those genera.

C. lucidulata, Walk., is stated "to present all the cha-

racters" of *Chrysolarentia*, Butl.; these are defined by Butler to be that the fore wings are "rather more acute" (than in *Larentia*, but the difference is imaginary), and that the hind wings are "usually yellow;" it is impossible to regard this as a generic characterization.

Eubolia undulata, Ros., is a species of *Cephalissa.*

The specimens identified (probably quite correctly) as *Coremia permissata*, Walk., and *C. regulata*, Walk., are (according to Dr. Lucas's types) both identical with *Epyaxa subidaria*, Gn.

Coremia languescens, Ros., is a species of *Cephalissa.*

Diptychophora ochracealis, Walk. Mr. Rosenstock appears to have overlooked my correction of the synonymy of this.

Thinasotia aurantiaca, Meyr. This identification is incorrect, unless Dr. Lucas mixed the two species, which is improbable, as *T. aurantiaca* does not to my knowledge occur south of the Hunter River: the species intended is (according to Dr. Lucas's specimen) *T. bivittella*, Don. Both are correctly referred to the genus *Hednota.*

Sorocostia vetustella, Walk. Stated to be quite overlooked by me, and described as a new genus of Crambidæ; it is, however, a *Nola* (Lithosiadæ), and was of course intentionally omitted; it was described by Zeller again under the name of *Nola strictalis* (Verh. zool.-bot. Ges. Wien, 1872).

Prionophora ruptella, Walk. (quoted under *Ancylolomia*). Mr. Rosenstock has overlooked my reference of this species (confirmed by Zeller) to the Noctuina.

Tortrix leucaniana, Walk. This reference is certainly erroneous; the species intended is *T. glaphyrana*, Meyr. *T. leucaniana* is confined to New Zealand, without doubt, and could not be mistaken for *T. glaphyrana* by any one well acquainted with both (I have seen both in thousands), though the females are very similar, as in all the allied species. I have seen Dr. Lucas's types.

Bondia nigella, Newm. It is asserted, on the strength of the examination of one specimen, that veins three and four of the hind wings are from a point, and not remote, as stated by me. I have again examined the six specimens which I possess, and find that in all the veins are remote, as I originally stated, though to a variable degree; hence, while Mr. Rosenstock's observation may be quite correct, it fails to prove that mine was incorrect; the just inference is either that the one specimen was exceptional, or that the species varies more than was at first observed.

Tinea fraudulens, Ros. This specific name must positively be written *fraudulenta*, the form adopted being a frightful

solecism. The species is a good one, but it is not a true *Tinea*; it belongs to a new genus allied to *Tinea*, but distinguished from it (as correctly indicated by Mr. Rosenstock) by the antennæ, which are as long as the fore wings. I propose for this genus the name *Chrysoryctis*; to it may be referred also *Œcophora irruptella*, Walk. (nec Zell.), and *Incurvaria purella*, Walk., and I have several other species.

Adela chrysolamprella, Ros. This appears to be *Nemotois sparsellus*, Walk., of which *Adela laurella*, Newm., is also a synonym; it is a true *Nemotois*, not an *Adela*.

Hypertropha divitiosa, Walk. This was not overlooked by me, nor again is it a distinct species (I have compared Walker's type); it is identical with *desumptana*, Walk., of which (as I have noted elsewhere) *tortriciformis*, Gn., is the oldest name.

Eulechria leucopsina, Ros. This is a synonym of *Peltophora atricollis*, Meyr.

Œcophora apertella, Walk. I have not seen a specimen of what Dr. Lucas sent; but I have no hesitation in saying that it was not the species named, which is a yellow species of *Œcophora*, peculiar to New Zealand; probably the insect intended is not a true *Œcophora*.

Philobota athletica, Ros. This is a synonym of *Cosyra annularis*, Meyr.

Without entering into the subject of the other groups, I may say that *Discophlebia Lucasii*, Ros., is the female of *D. catocalina*, Feld.; the affinities of this curious insect need not be discussed here.

To this list of criticisms I should, in fairness, add that some genera and species appear to have been so carefully examined (considering the imperfect material available) that it is a pity the same attention was not bestowed upon all.

The King's School, Parramatta, N. S. W.
April 3, 1886.

LIII.—*Contributions to a Knowledge of Malayan Entomology.* Part V. By W. L. Distant.

The following descriptions are of butterflies received from the Malay Peninsula, an area which possesses a particularly rich Rhopalocerous fauna, and one which continually exhibits novelties in almost every collection.

RHOPALOCERA.

Fam. Nymphalidæ.

Subfam. *Satyrinæ.*

Elymnias abrisa, n. sp.

Male. Wings above dark obscure indigo-blue, posterior wings with a large submarginal pale bluish patch. Wings beneath glossy brownish, much mottled with paler strigæ; anterior wings with the basal half of costal area and apical margin castaneous, and with a large triangular pale subapical patch; posterior wings with a subcostal castaneous patch, a pale stramineous spot between the subcostal nervules, and the outer half of wing with the ground-colour pale violaceous and having a few small submarginal spots. Body and legs more or less concolorous with wings.

Exp. wings 70 millim.

Hab. Province Wellesley (*coll. Dist.*).

This species is allied to the *E. sumatrana*, Hew., from which it differs by the pale patch on the upper surface of the posterior wings, and by the subcostal stramineous spot beneath.

An unlocalized and unidentified specimen in the Hewitsonian collection is clearly the female of this species, and also differs strongly from the corresponding sex of *E. sumatrana*.

Fam. Lycænidæ.

Logania sriwa, n. sp.

Wings above violaceous white; anterior wings with the costal margin spotted with fuscous and the apical area (not quite reaching to outer angle) dark fuscous; posterior wings with the fringe spotted with fuscous. Wings beneath fuscous-brown with darker blotches, and irrorated and speckled with greyish white; this whitish coloration is most prominent on the anterior wings at apex and outer angles; and on the posterior wings it appears as an irregular broad subcostal streak, the posterior wings are also more darkly marked than the anterior. Body above brownish, beneath greyish; legs very pale brownish with dark annulations.

Exp. wings 24 millim.

Hab. Malacca (*coll. Staudinger*).

Zizera? * *usta*, n. sp.

Wings above violaceous brown. Wings beneath greyish

* I place this species provisionally in the genus *Zizera*, from which it differs by having the first subcostal nervule completely anastomosed

ochraceous; anterior wings with two contiguous fuscous spots at centre of cell, a fuscous discocellular spot at end of cell, and five spots of the same colour in a curved submarginal series; posterior wings with two large black spots near costal margin, the outermost with a small fuscous spot beneath it, a small fuscous spot in cell, and a discocellular streak of the same colour at end of cell, and with the following blackish spots:—one beneath and near base of cell, two near abdominal margin, one near anal angle, and four in a curved series beyond cell, and with a double series of pale fuscous, linear, submarginal spots; fringe of both wings fuscous. Body and legs more or less concolorous with wings.

Exp. wings 20 millim.

Hab. Malacca (*coll. Staudinger*).

Polyommatus bagus, n. sp.

Female. Wings above closely resembling those of the same sex of *P. bœticus*. Wings beneath pale brownish ochraceous, with the following linear brownish fasciæ margined with greyish:—both wings with two at end of cells and two submarginal fasciæ, the innermost broadest; posterior wings with two large, marginal, blackish spots, containing a few scattered greenish scales and inwardly margined with pale reddish ochraceous, separated by the lower median nervule. Body above more or less concolorous with wings, beneath with legs greyish white; legs more or less streaked with brownish.

Exp. wings, ♀ 30 millim.

Hab. Province Wellesley (*Birch, coll. Distant*).

BIBLIOGRAPHICAL NOTICE.

Memoirs of the Geological Survey of India. Palæontologia Indica, being Figures and Descriptions of the Organic Remains procured during the Progress of the Geological Survey of India. Ser. iv. *Indian Preterttiary Vertebrata.* Vol. I. Part 5. *The Reptilia and Amphibia of the Maleri and Denwa Groups.* By R. Lydekker, B.A., F.G.S., &c. With 6 plates. Calcutta: Geological Survey Office. London: Trubner & Co. 1885.

Reptilian fossils have been obtained from the Maleri rocks of India in two localities, Maleri (about thirty miles north of the Godaveri, in the central provinces) and in the coal-field of South Rewah. The

with the costal nervure. The typical specimen, however, is not only unique, but also not my own property, thus preventing that detailed structural examination which is necessary for exact generic determination, but which is liable at the same time to injure the specimen.

age of these beds is determined as Upper Trias. The fauna described includes *Hyperodapedon Huxleyi*, a species of *Belodon*, *Parasuchus Hislopi*, a Dinosaur, a *Mastodonsaurus*, and some other forms. *Hyperodapedon*, as originally described from Scotch specimens, had a skull about 7 inches long and 5 inches wide; but the new species is estimated to have had the skull 20 inches long and a skeleton fully 17 feet in length. The evidence for the existence of this animal consists in bones of the skull, vertebræ, and bones of the extremities. The most important remains are the palato-maxillary bones, some of which are of about the size of those of *Hyperodapedon Gordoni*.

But in the largest specimen the palatine teeth consist of three main rows, with a few teeth indicating a fourth row. The first row of maxillary teeth is regular in arrangement, but the external rows are so irregular that the number of rows cannot be counted, though it appears to be six. In all essential characters the resemblances of this type to *Hatteria* are remarkable. There are fragments of mandible which also show characters like those of *Hatteria*, and the worn condition of the teeth in mandible and skull indicate a backward and forward motion of the jaw. The teeth penetrate deeply into the bone; those which border the palato-maxillary groove of the skull were worn down by the marginal rows of mandibular teeth, and the second and third rows of palatine teeth were worn by the lateral mandibular teeth.

The thoracic vertebræ show articular surfaces for the intervertebral wedge-bones or intercentra, such as characterize *Hatteria*. The neural arch, however, was not anchylosed to the centrum; it carried the dorsal half of the tubercle for the rib.

Considering the large size of the animal, it is remarkable that the correspondence to *Hatteria* should extend to the sacral vertebræ, the shoulder-girdle, humerus, ulna, ilium, and other bones, which are provisionally referred to this genus on account of the resemblance to that type.

Mr. Lydekker remarks that the presence of the median ridge in the palato-maxillary bones of the remains from South Rewah may perhaps indicate a distinct species from that found at Maleri.

The *Hyperodapedon Huxleyi* is distinguished from the British species by its larger size and by having a greater number of rows of teeth in the maxillary than in the palatine bone. This condition is the reverse of that seen in *Hyperodapedon Gordoni*. Other distinctive characters are the triangular cross section of the teeth of the first rows of the palatine and maxillary series, the absence of teeth on the inner surface of the palatine bone, and a steady increase in size of teeth from the front to the back of the jaws.

The author considers that the characters of the fossils described indicate a genetic connexion between the Rhynchocephalia, through *Endothiodon*, and the more typical Anomodontia. The well-developed articular ends of the limb-bones are taken to indicate that these animals lived on land.

The specimens referred to *Belodon* were found at Tiki, in South

Rewah. They consist of a basiocoipital and basisphenoid, with minute fragments of the maxillary bone and a dorsal vertebra. The evidence of the genus *Parasuchus*, a crocodilian type from Maleri, consists of similar remains rather better preserved, and includes the articular part of the quadrate bone, a fragment of the premaxillary, and what the author regards as dermal scutes. It is considered that some other fragments indicate a Dinosaur; but the remains are not of that conclusive character that might be desired, consisting of a fragment of a dorsal vertebra of Teleosaurian type, a caudal vertebra, and a phalange. The phalange has a more Dinosaurian aspect than the other bones. There are some teeth, referred to the same type, which resemble the hinder teeth of *Belodon* as well as *Thecodontosaurus*.

The remains of *Mastodonsaurus* are said to consist of the right supratemporal bone found in the Denwa group, on the Denwa river, in the Satpura district. Other fragmentary specimens are stated to be allied to *Metopias* of Von Meyer and *Capitosaurus* of Munster. A portion of a maxillary bone shows teeth with folded enamel, each having a quadrate base with a pulp-cavity. There are also fragments of cranial bones, mandible, and vertebræ. All these remains are of so fragmentary a character that more than ordinary courage was needed to refer to them at all, and the conclusions adopted are necessarily speculative. The volume concludes with a list of memoirs which relate to these fossils, followed by a synopsis of the Pretertiary Indian Vertebrata.

MISCELLANEOUS.

Some new Infusoria from American Fresh Waters.

In the 'Annals' for February last, under the above title, the present writer published an article in which a new genus of Infusoria was formulated with the name *Diplomastax*, the word *Diplomestoma*, which I had selected and written in my MS., having been cancelled by the Editors under a misapprehension for which I gave them one excuse, it seems, by my mistake in writing "*Diplomastax*" in the explanation of the plate, and another by deriving *Diplomestoma* in an utterly impossible way, according to the editorial note in the April number of the magazine. Therefore, since *Diplomastax* is preoccupied and the derivation of *Diplomestoma* is offensive to the purist, I withdraw it and substitute the name *Dallasia*, in honour of Mr. W. S. Dallas, F.L.S., Assistant Secretary of the Geological Society, to whom it affords me much pleasure to dedicate the genus, the name of the species described thus becoming *Dallasia frontata* instead of *Diplomestoma frontata*.

Dr. A. C. Stokes.

Trenton, New Jersey, U. S. A.

On Entoniscus mænadis. By M. A. Giard.

Almost at the moment when I made known the existence on the French coasts of the *Entoniscus* parasitic upon *Pachygrapsus marmoratus*, Fab.*, P. Fraisse met with this curious Isopod in the Bay of Naples, that is to say in the locality where it was discovered in 1787 by Cavolini. Fraisse further stated † that he had found the same parasite in *Carcinus mænas*, but he did not establish the correctness of this determination by the comparative examination of the embryos, which furnish the best specific characters in creatures which are so profoundly modified in the adult state. As I had observed at various points on the shores of the Channel embryos of *Entoniscus* which had strayed into the incubatory cavity of *Sacculina Carcini*, I repeatedly sought for *Entoniscus* in *Carcinus mænas*, but always without success, notwithstanding the great number of crabs which were sacrificed for this purpose.

I have been more fortunate this spring, and the first crab which I opened at Wimereux furnished me with a fine *Entoniscus*, the ovigerous lamellæ of which contained perfectly mature embryos. The infested *Carcinus mænas* was a female of middle size, bearing a *Sacculina* the incubatory cavity of which was empty. The *Entoniscus* was placed on the left side of the crab, in the midst of the hepatic cæca of its host.

This *Entoniscus*, which I shall call *Entoniscus mænadis*, is very distinct from *Entoniscus Cavolinii*. The liquid which circulates in the vessels contrasts by its red colour with the orange-yellow ground of the ovarian mass. The ovigerous sac, or, to be more exact, the mass of embryos ready for exclusion, presents a mauve-grey coloration, very different from the leaden tint of *Entoniscus Cavolinii* loaded with ova in the same stage of development. The embryo, especially, presents easily recognizable differential characters. We find no trace of the remarkable Nauplian eye, the existence of which I have indicated in the parasite of the *Grapsus*. The crystallines of the lateral eyes are more approximated, and from these eyes there start, on each side of the head, arcs of a reddish-brown pigment which meet upon the median part of the forehead. The sixth pair of thoracic legs presents nearly the same conformation as the corresponding pair in the embryo of *E. Cavolinii*; nevertheless the terminal rod is shorter, and does not support a tuft of hairs as in the latter. From this point of view *E. Cavolinii* and *E. mænadis* differ greatly from *E. Salvatoris*, Kossmann, in which the six pairs of thoracic feet are all similar ‡.

Kossmann has placed beyond doubt the existence of the male in the European *Entonisci* §. Further, he has supposed that in the

* 'Comptes Rendus,' August 12, 1878.

† Arbeiten a. d. zool.-zoot. Inst. zu Würzburg, Bd. iv. 1878.

‡ I resume, for the parasite of *Portunus arcuatus*, the name originally given by Kossmann, because this parasite appears to me to be specifically distinct from that of *Portunus puber*, *E. Moniezii*, with which Kossmann would identify it.

§ See Kossmann's paper translated in the Ann. & Mag. Nat Hist. ser. 5, vol. x. p. 81.

species of the allied genus *Cryptoniscus* there is hermaphrodism with successive functioning of the two sexes and *protandry*. This hypothesis, strongly supported by the investigations of Bullar and Paul Mayer upon the Cymothoadina, appears to me to be very acceptable in the present state of our knowledge, and I willingly extend it to the genera *Hemioniscus* and *Entoniscus*, and even to other less abnormal Bopyrina, such as *Ione thoracica*, which is also found at Wimereux in the branchial cavity of *Callianassa subterranea*. We should thus easily explain how, in the case of animals so rare as the *Entonisci*, Fraisse and myself were able to find, comparatively often, upon the same crab, two or even three female individuals in different stages of development and unaccompanied by any male *.

The young imperfectly developed females would in this case be males, which, after having functioned as such, had succeeded in attaching themselves directly upon the crab, and continued their evolution as females, thanks to the more perfect nutrition which they would obtain in their new position. The great dimensions of the sac occupied by the *Entoniscus* leaves, after the escape of the embryos, a free space much greater than in the case of the true *Bopyri*, and facilitates this change of place of the male, the activity of which is sufficient.

Sacculina Carcini is not very common at Wimereux; the *Entoniscus* is very rare there. The coincidence of these two parasites upon the same crab therefore possesses a real interest, especially if we connect this observation with those made by Fritz Müller upon *E. Porcellanæ*, and by Fraisse upon *E. Cavolinii*. It is, it seems to me, a fresh example of what I have called the mutual assistance or the successive association of parasites in a determinate order, each species preparing the soil for those which are to follow it. Demonstrated first among the insects, this law seems to me to be of very general application, and it will doubtless furnish valuable indications in comparative pathology when it is applied to parasites of a lower grade, animal or vegetable.—*Comptes Rendus*, May 3, 1886, p. 1034.

On the Calcareous Sponges of Minorca. By M. Lakschewitz.

M. Lakschewitz has communicated to the Dorpat Society of Naturalists a preliminary note on the calcareous sponges of Minorca, founded upon collections made in 1882 by Prof. M. Braun, chiefly in the harbour of Mahon and the Alcanfa inlet. He adopts Häckel's classification.

Order CALCISPONGIÆ.

Fam. 1. Asconæ.

1. *Ascetta primordialis*, Häck.

Most of the specimens are flat cushion-like stocks of 10–40 millim.

* Fraisse found the *Entonisci* upon seven females of *Carcinus mænas* without ova, one of these crabs bore two and the other three parasites. Upon a single *Portunus puber* I found two unequally developed specimens of *Entoniscus Moniezii*, the only individuals of this species that I have been able to observe.

in diameter. They consist of anastomosing tubes, usually opening in groups through common oscula (*Tarrus primordialis*, Häck.), more rarely quite astomatous (*Auloplegma primordiale*, Häck.). Varieties *Ascetta protogenes* and *A. dictyoides*, Hack., are represented among the Minorcan specimens. Triradiates regular.

Loc. Mahon, Alcanfa, apparently very abundant.

2. *Ascetta clathrus*, Häck.

Two astomatous *Auloplegma*-stocks of 30–35 millim. in diameter. The loose tissue formed of slender tubes. Triradiates with slender cylindrical rays, sometimes slightly undulated, apices a little thickened. Both specimens belong to the var. *mæandrina*.

Loc. Mahon; previously known from the Adriatic.

3. *Ascetta blanca*, Hack.

Among the few specimens are some which as single individuals form a spindle-shaped sac with a naked osculum (*Olynthus*). One is a *monoblastic Nardorus*-stock with a common osculum, and another possesses several oscula (*Soleniscus*).

Loc. Mahon; previously known only from the Canary Islands.

4. *Ascaltis canariensis*, Hack.

All astomatous polyblastic stocks, often furnished with one or more pseudostomata, leading into vacuities of the canal-system. They belong to the variety *Ascuris arrecifæ*, Hack.

Loc. Mahon; only known from the Canaries.

5. *Ascaltis minoricensis*, sp. n.

"Triradiates and quadriradiates regular (equiangulate and equiradiate) and of the same size. Rays 7–10 times as long as thick, slenderly conical. Apical ray of the quadiradiates straight, half as thick as the three facial ones. Colour in alcohol white or brown."

Loc. Mahon.

Two specimens are large astomatous *Auloplegma*-stocks, 40–50 millim. in diameter. A third is a monostomatous stock with a common proboscidiform aperture.

Fam. 2. Leucones.

6. *Leucaltis pumila*, Häck.

Most of the specimens are large polyblastic stocks with several naked proboscidiform apertures. Some of them attain a diameter of 70 millim., and one is an astomatous stock with a rather narrow gastral cavity.

It is singular that Häckel describes only solitary personæ of small size; the Minorcan specimens are among the largest of calcareous sponges. In the structure of the skeleton they agree exactly with Häckel's description; it consists chiefly of nearly regular triradiates, while the gastral surface and those of the canals are lined with regularly arranged small quadriradiates, the basal ray of which is straight and somewhat longer than the curved lateral ray.

Loc. Mahon; previously known from the Atlantic and Indian Oceans.

7. *Leucandra aspera*, Häck.

A single specimen with a proboscidiform aperture (*Dyssyconella aspera*, Häck.).

Loc. Mahon; widely distributed in the Mediterranean.

8. *Leucandra balearica*, sp. n.

"Dermal surface spinose, as also the gastral surface. Chief part of the skeleton consisting of regular triradiates. The triradiates of the dermal cortex and the gastral quadriradiates are enveloped by minute bacillar spicules (*Stäbchenmörtel*). Scattered in the parenchyma are colossal fusiform spicules which project but little. The globular flagellate chambers are seated racemosely on the branched canals. The specimens are solitary personæ, partly without a mouth-aperture and partly with a fringed aperture."

Loc. Mahon.

9. *Leucandra Rodriguezii*, sp. n.

"Dermal surface setosely spinose. Gastral surface spinose. Chief part of the skeleton consisting of regular triradiates; the cortical layer thickly permeated by colossal, fusiform, and long, very fine, cylindrical spicules (*Stricknadeln*). The triradiates of the dermal cortex and the gastral quadriradiates enveloped by 'Stäbchenmörtel.' Large astomatous stocks."

Loc. Mahon and Alcanfa.

Fam. 3. Sycones.

10. *Sycandra coronata*, Häck.

Peristome in all specimens surrounded by an elegant circlet (*Sycarium coronatum*).

Loc. Mahon; widely distributed in the Mediterranean.

11. *Sycandra raphanus*, Häck.

The specimens are individual personæ, one with a naked mouth-aperture (*Sycurus raphanus*, Häck.), the others all Sycariiform.

Loc. Mahon, Alcanfa; widely distributed, Mediterranean, Indian Ocean, Australia, Philippines.

12. *Sycandra setosa*, Häck.

Two single personæ, with a long peristomial circlet.

Loc. Mahon; common in the Mediterranean.

13. *Sycandra Schmidtii*, Häck.

A specimen with proboscidiform mouth-aperture.

Loc. Mahon; also in the Adriatic.

14. *Sycandra elegans*, Häck.

All solitary personæ, bearing a horizontal spicular circlet besides the peristomial circlet.

Loc. Mahon and Alcanfa; common in the Mediterranean.

15. *Sycandra Humboldtii*, Häck.

One specimen agreeing in skeletal structure with this species, but its peristome is much produced.

Loc. Mahon; previously known from the Adriatic.—*Sitzungsb. Naturf.-Gesellsch. bei der Univ. Dorpat*, Band vii. pp. 336–341.

On a new Rhizopod, Arcyothrix Balbianii. By M. Paul Hallez.

In his culture of the ova of *Ascaris megalocephala* Prof. Paul Hallez discovered a very curious Rhizopod, to which he has given the name of *Arcyothrix Balbianii*. It measures from 20 to 65 μ according as it is more or less extended. Its irregularly globular body has its lower surface flattened into a pedal disk, and the form of the animal when creeping resembles that of a jockey-cap. Its protoplasm is transparent and contains, besides granules and vacuoles, a large contractile vesicle, which M. Hallez found to communicate with the exterior. He was unable to ascertain whether the animal had a nucleus, as the employment of colouring agents would have killed the ova under observation. This Rhizopod presents appendages of two kinds, namely (1) a digitiform contractile pseudopodium presenting slow movements of oscillation and rotation, and (2) two very long and slender filaments of varicose aspect and often bifid, which serve to retain what the pseudopodium has seized. They are inserted upon two mamillæ, which are pretty close together, and in contracting they may form a spiral resembling that of the peduncle of the *Vorticellæ* *.

These appendages play no part in the locomotion of the animal, which is a simple reptation of the protoplasmic mass. Although M. Hallez has only once met with this Protozoon and could not study its development, his discovery of it is of considerable importance. The simultaneous presence of the pseudopodium of the Amœbans and of the filaments of the Heliozoa leads to the supposition that *Arcyothrix Balbianii* may be regarded as a type intermediate between these two groups. (The outline figure given of the animal (a side view) shows a depressed irregular cone having the flat creeping surface below and the single pseudopodium springing from the apex. Two long slender threads, thickened at intervals, spring from two conical projections on one side of the cone, and a flagellate Infusorian is shown as retained by one of these filaments. The contractile vesicle is placed immediately beneath the base of the lower of the two filaments.)—*Mémoires de la Société des Sciences de Lille*, sér. 4, tome xiv.; *Bull. Scient. du Dép. du Nord*, October 1885, p. 323.

* *Podostoma filigerum*, according to Claparède, can retract the filaments which it emits in the same way.

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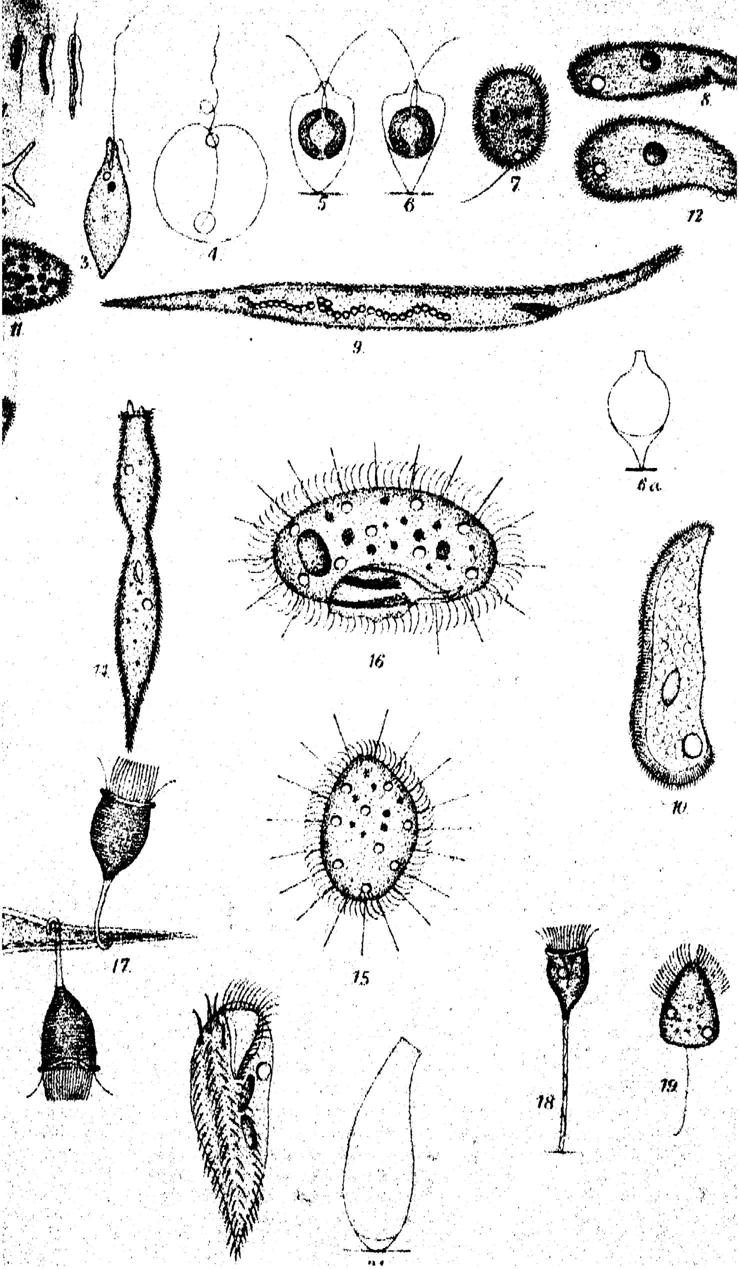

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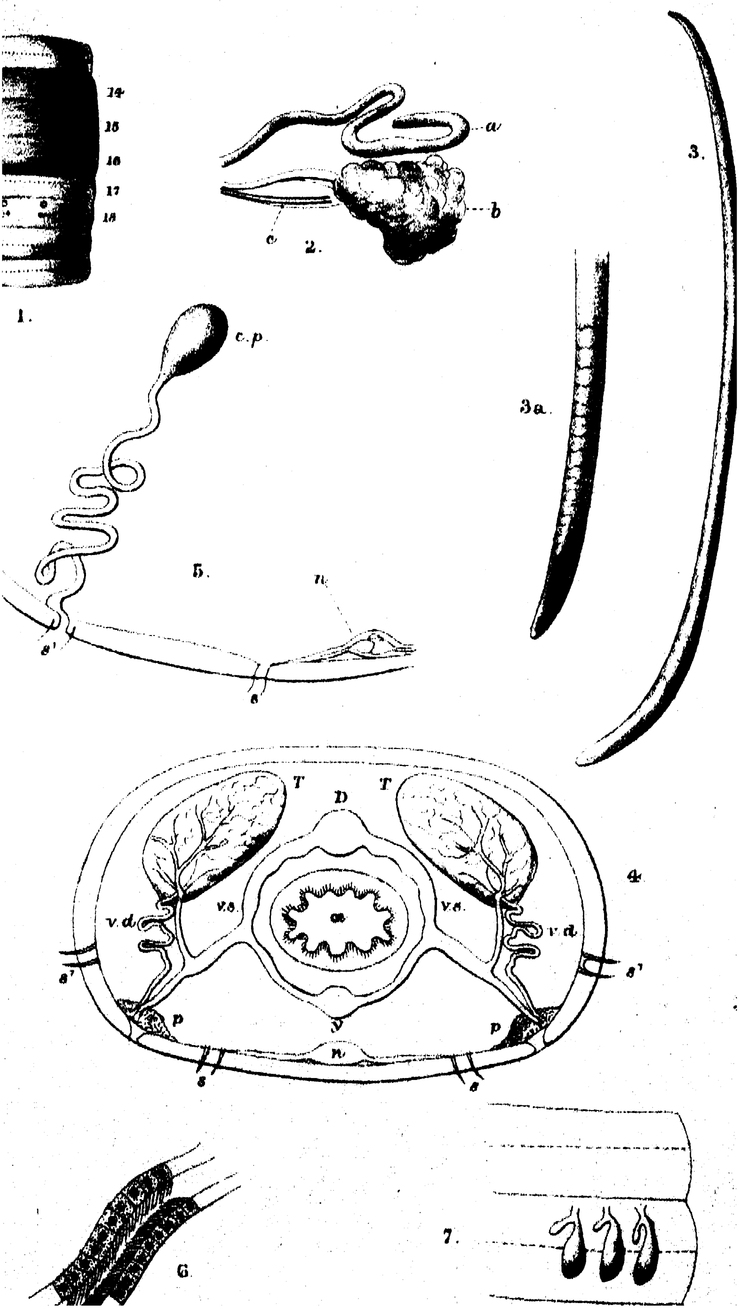
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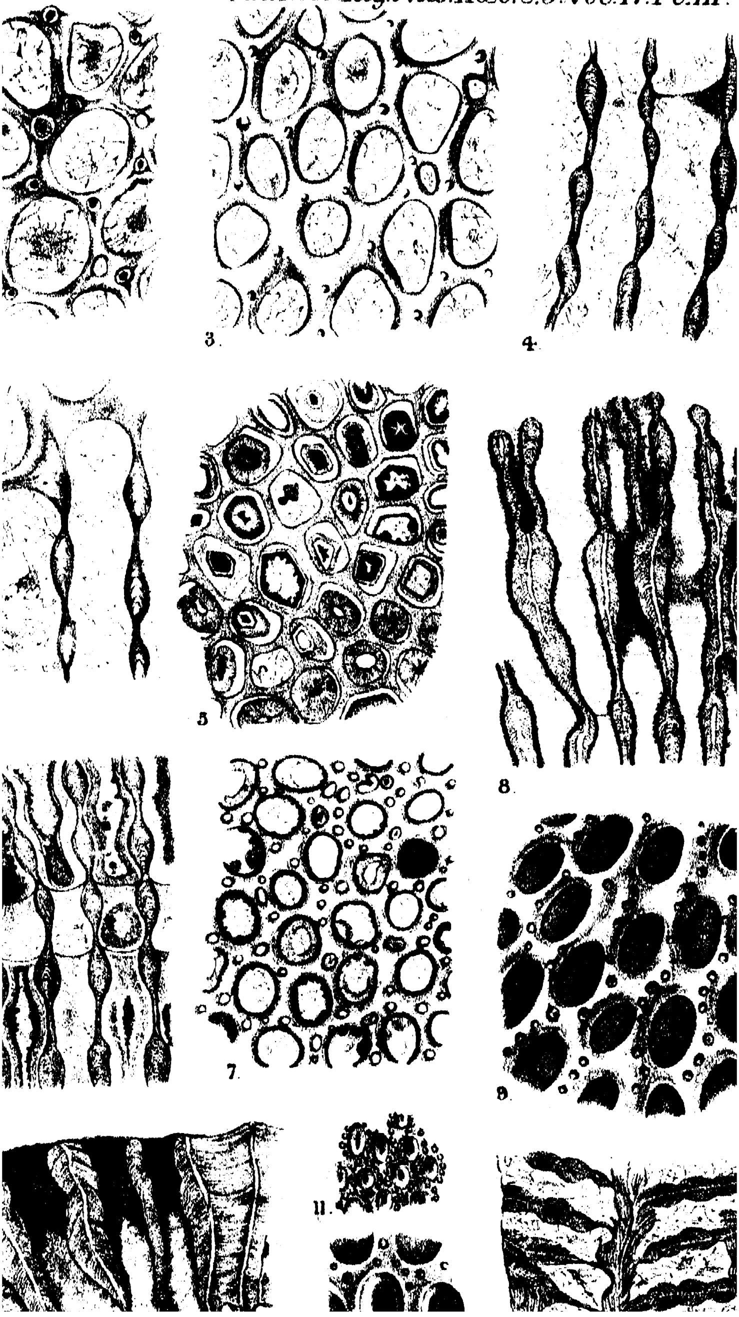
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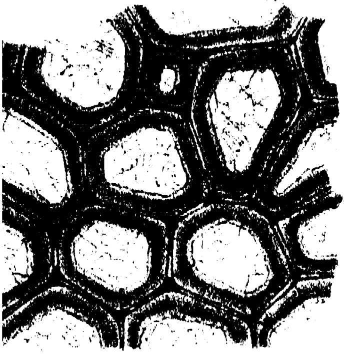

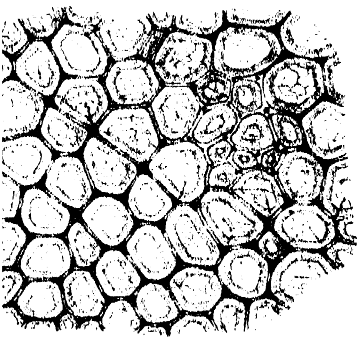

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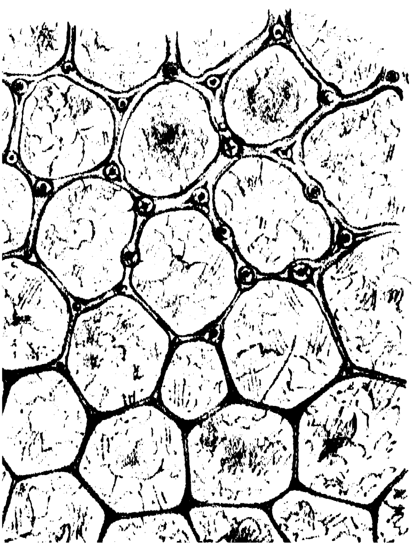

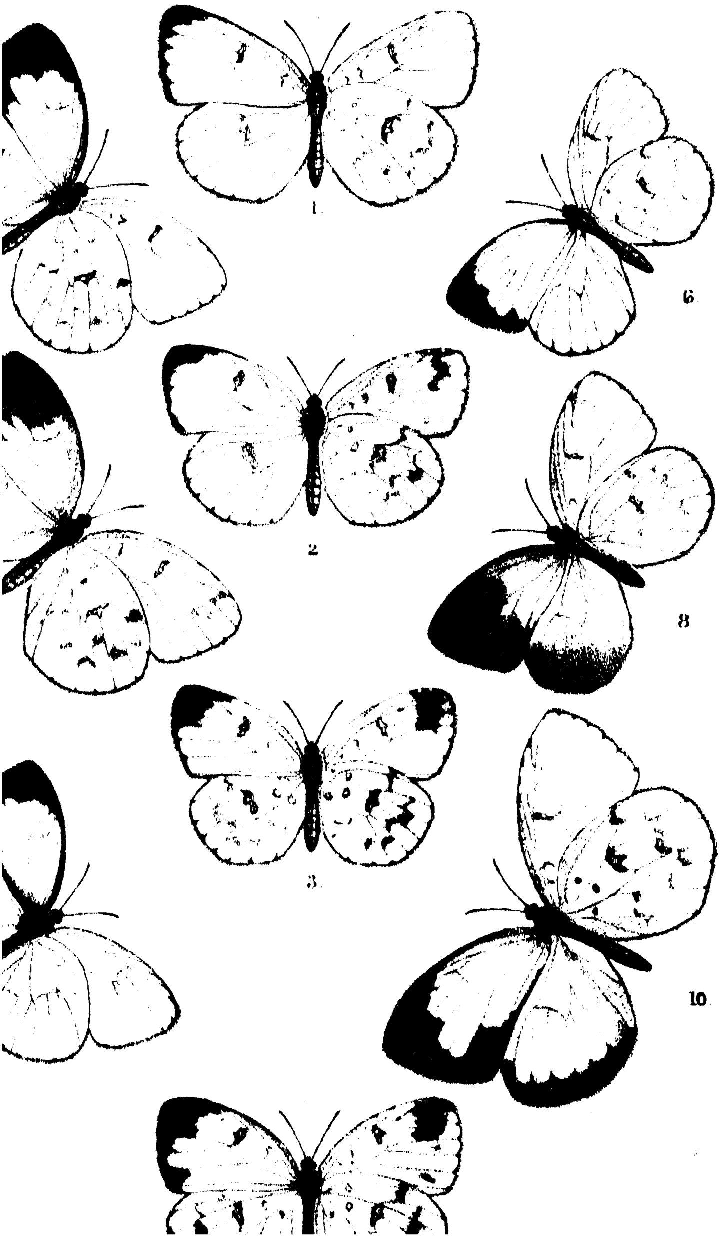
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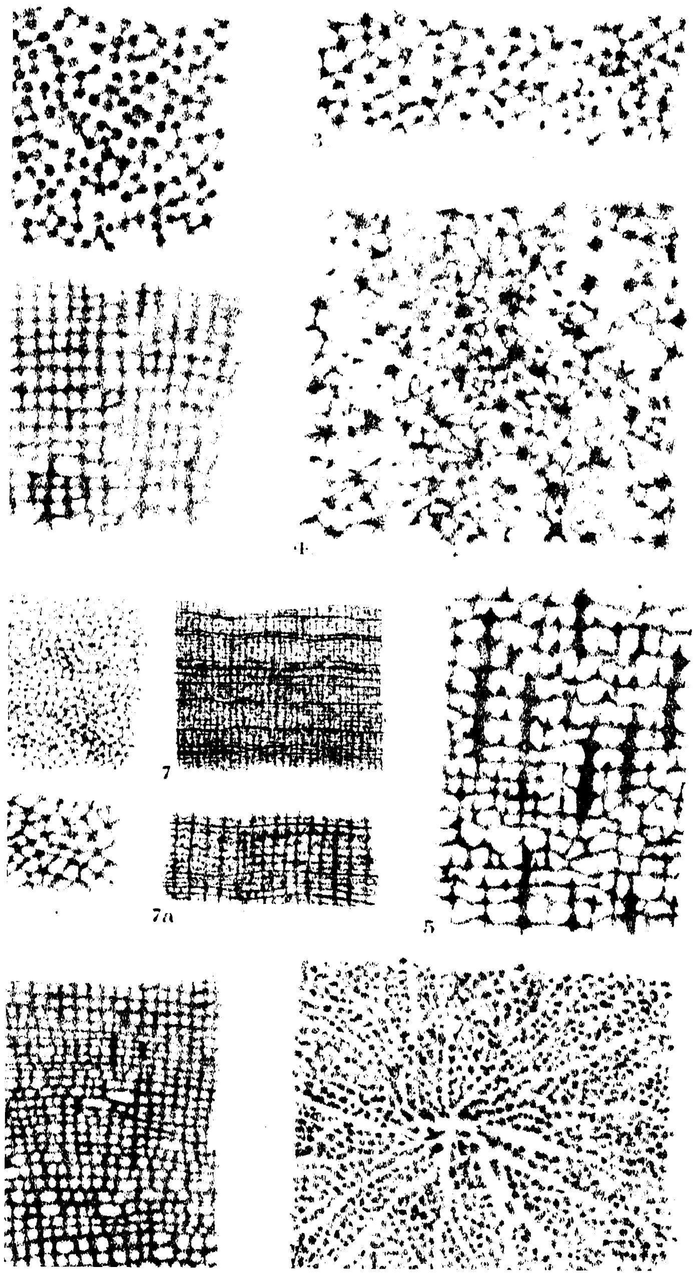
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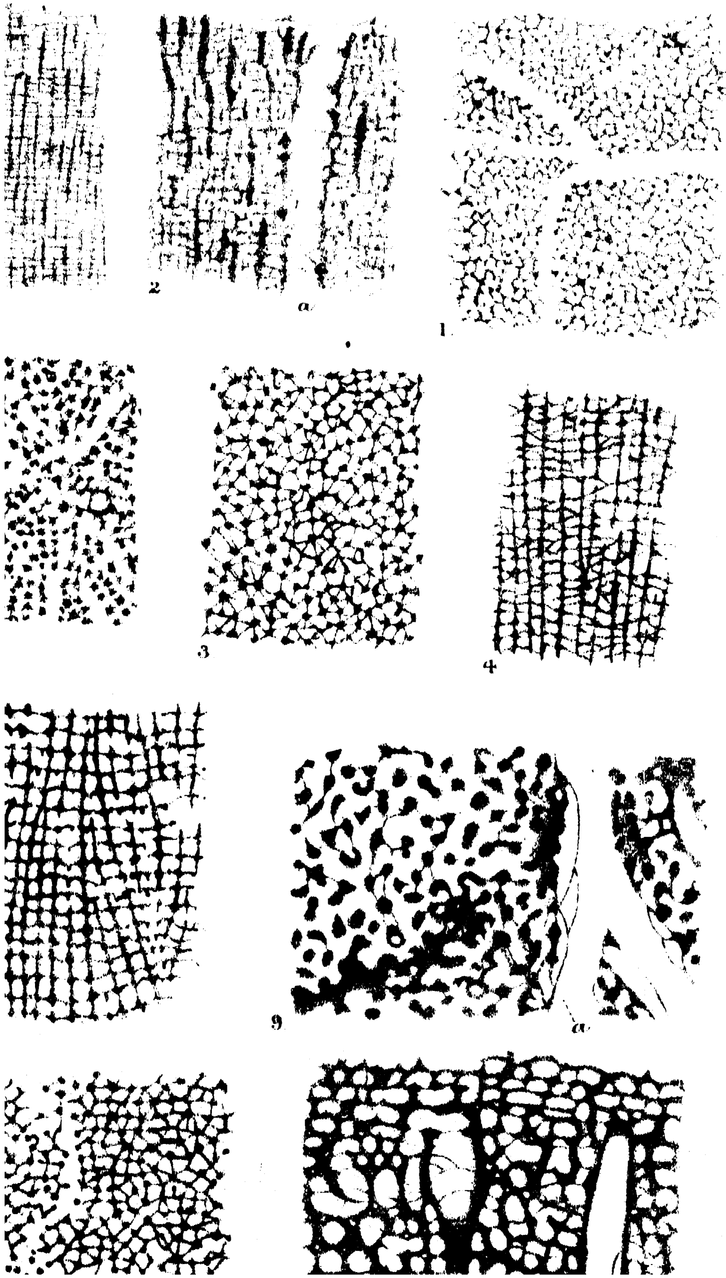
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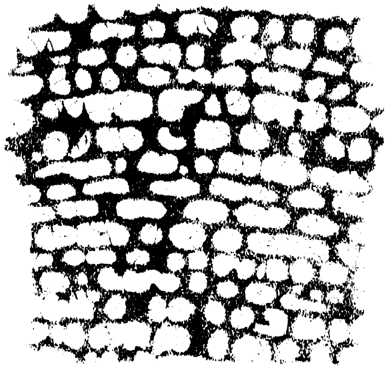

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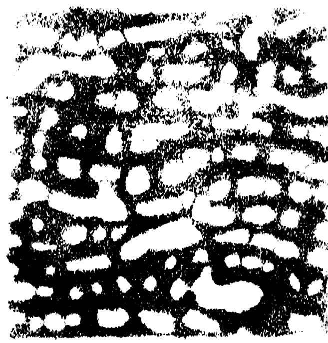

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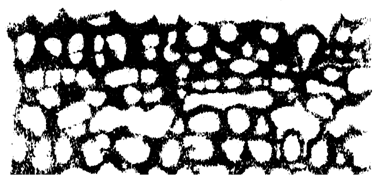


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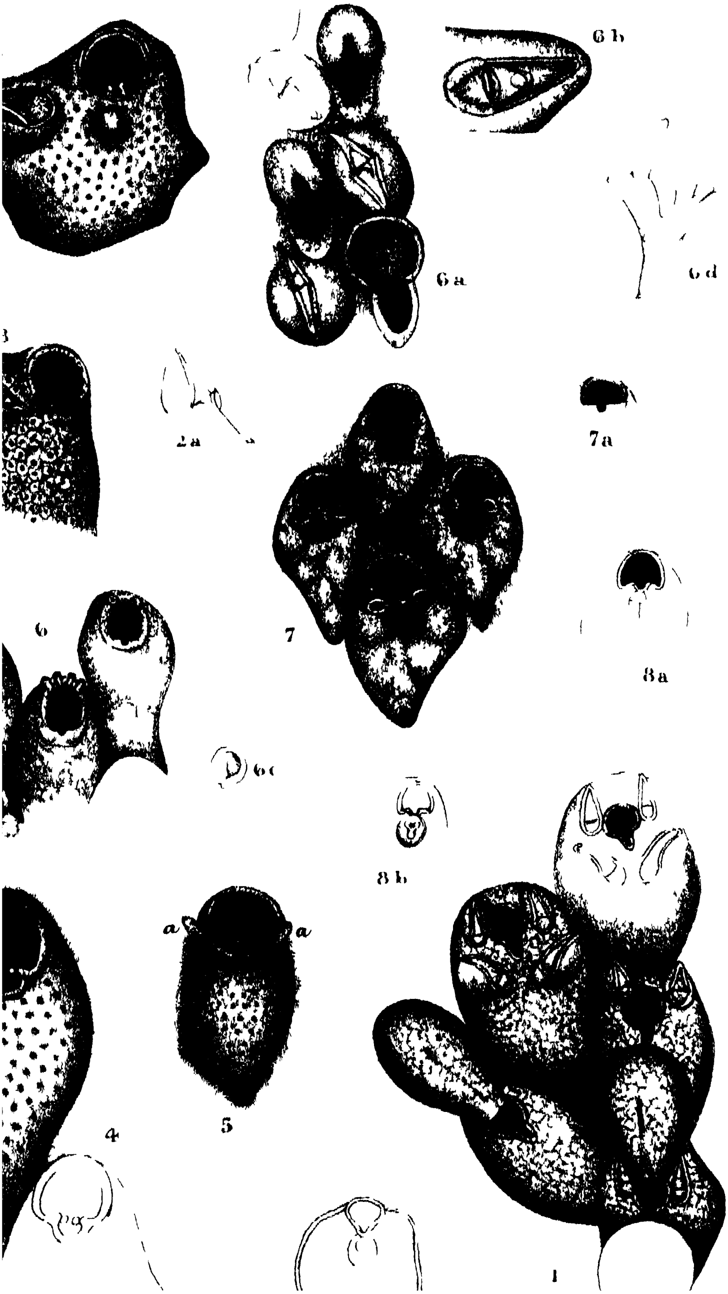
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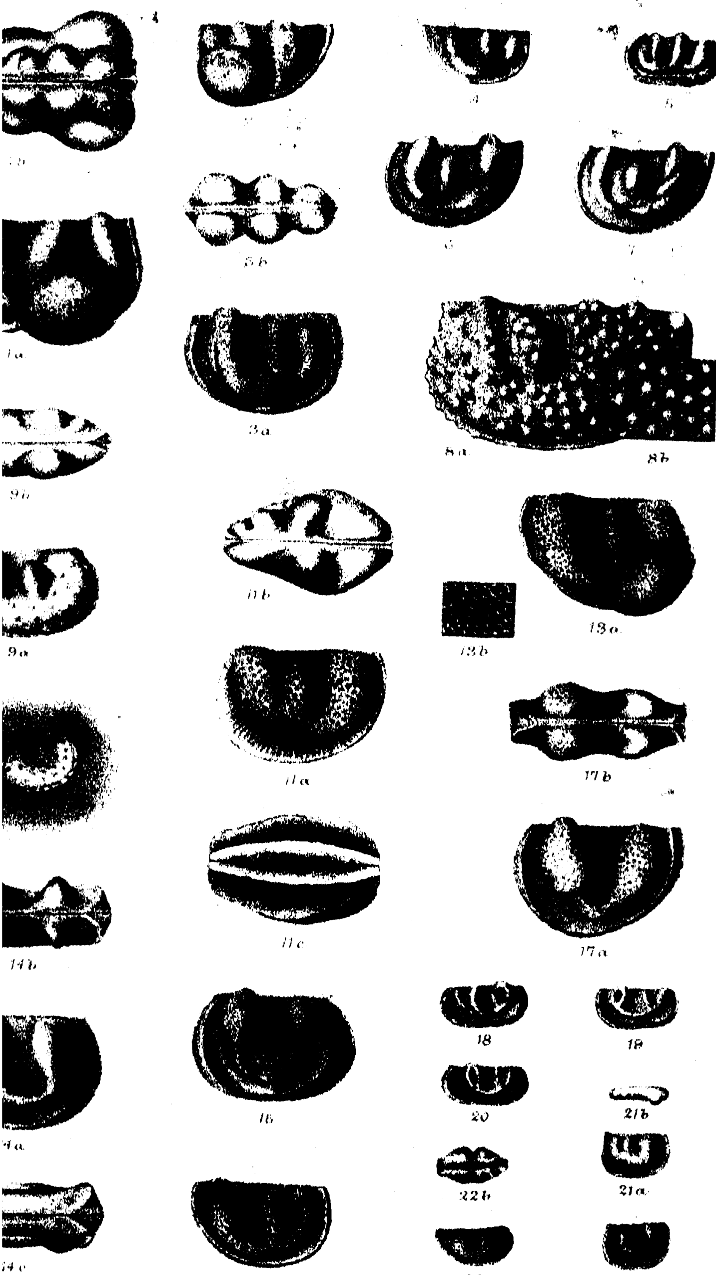
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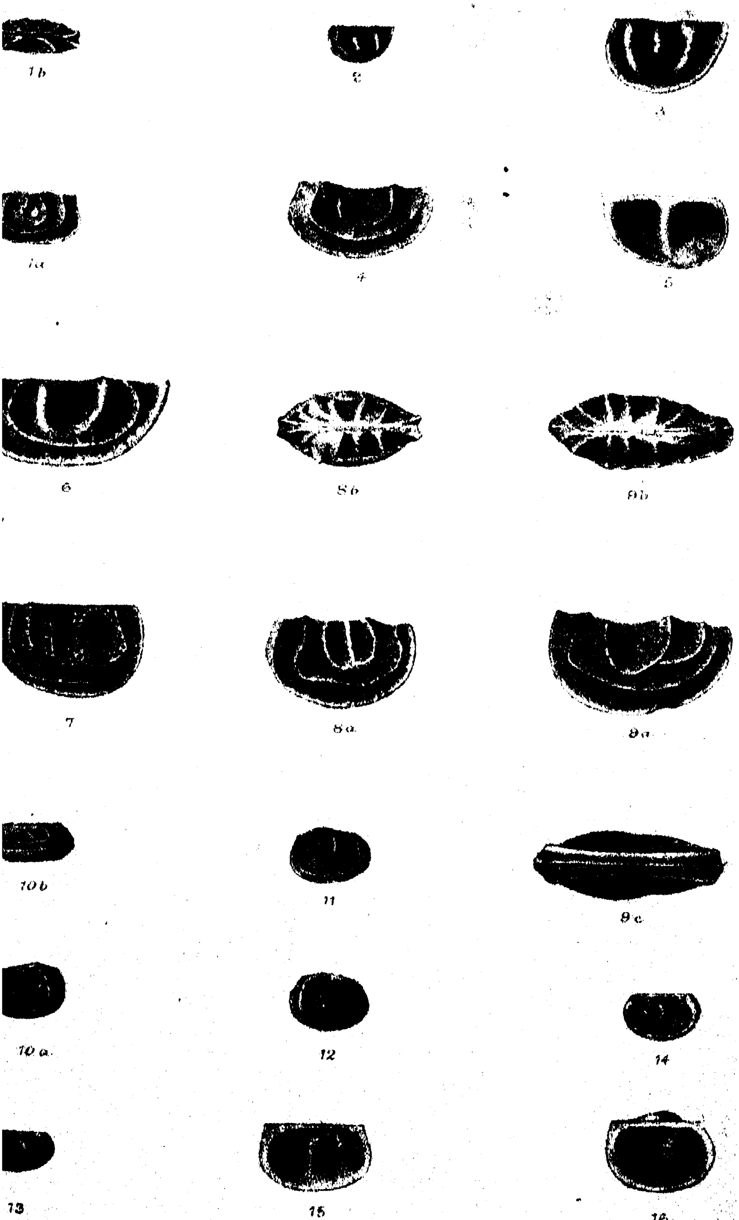

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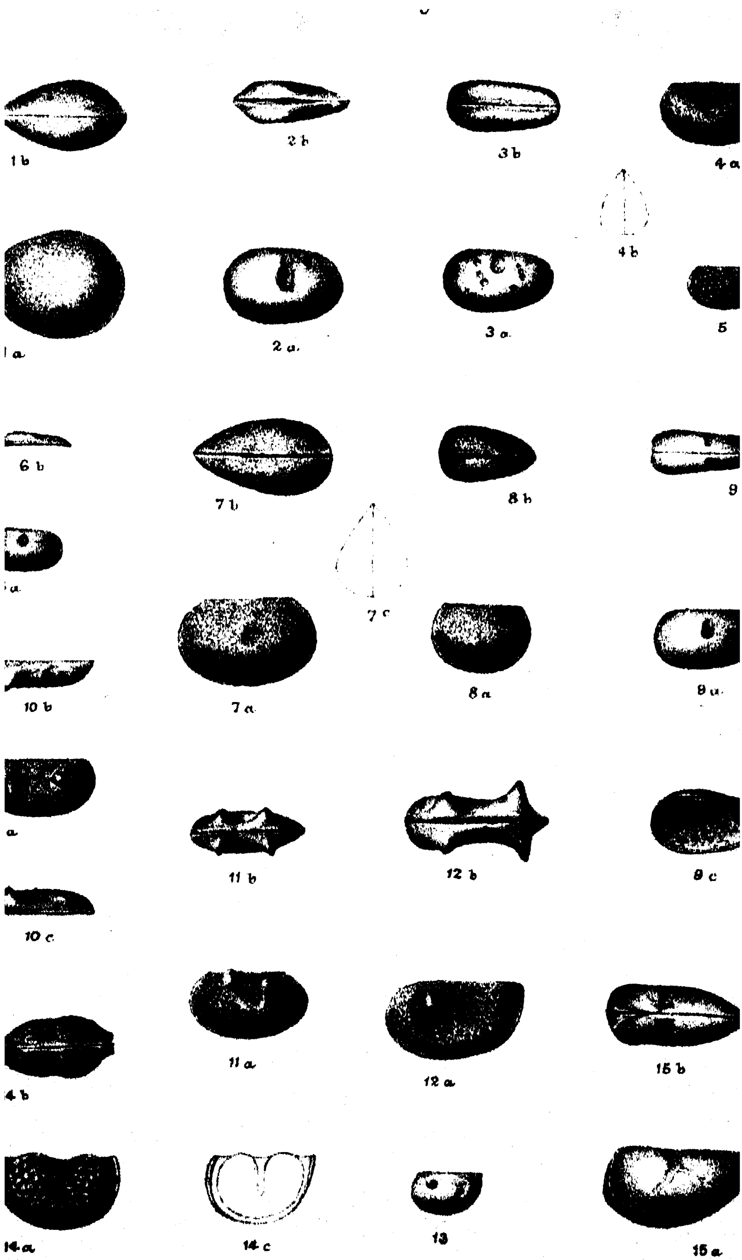

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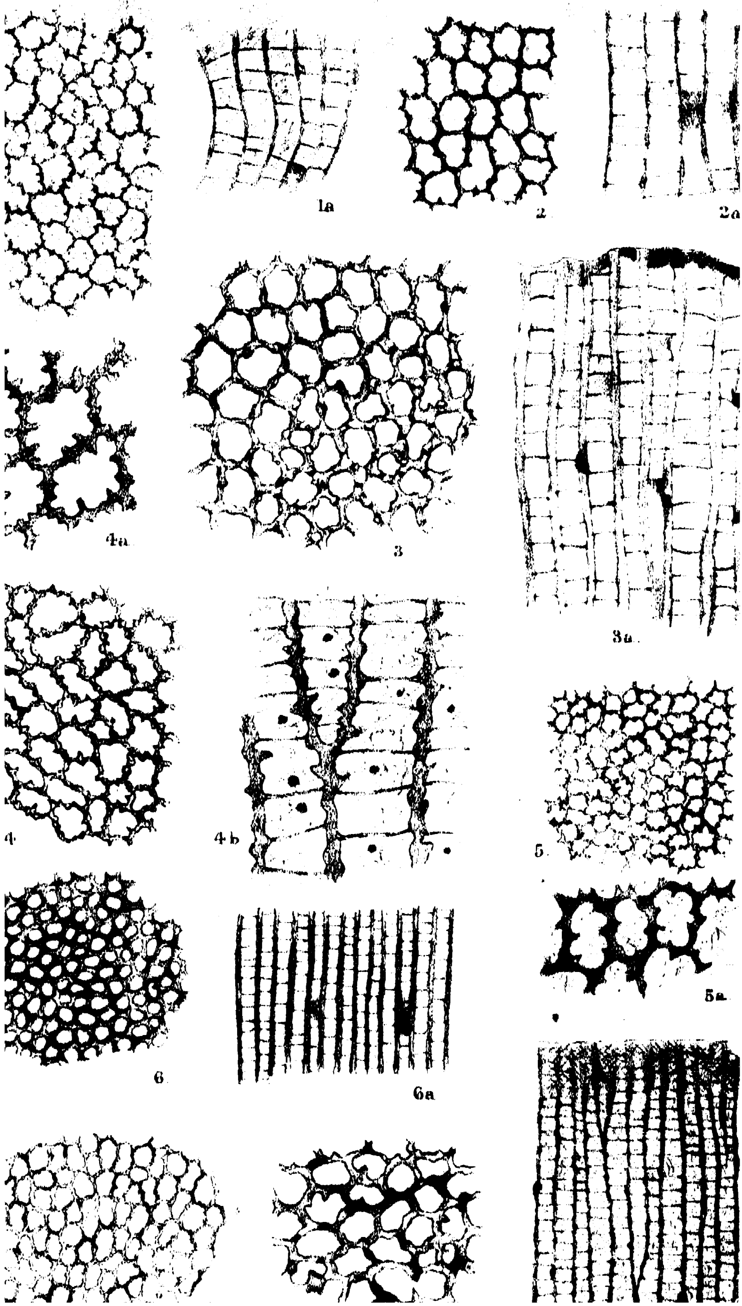
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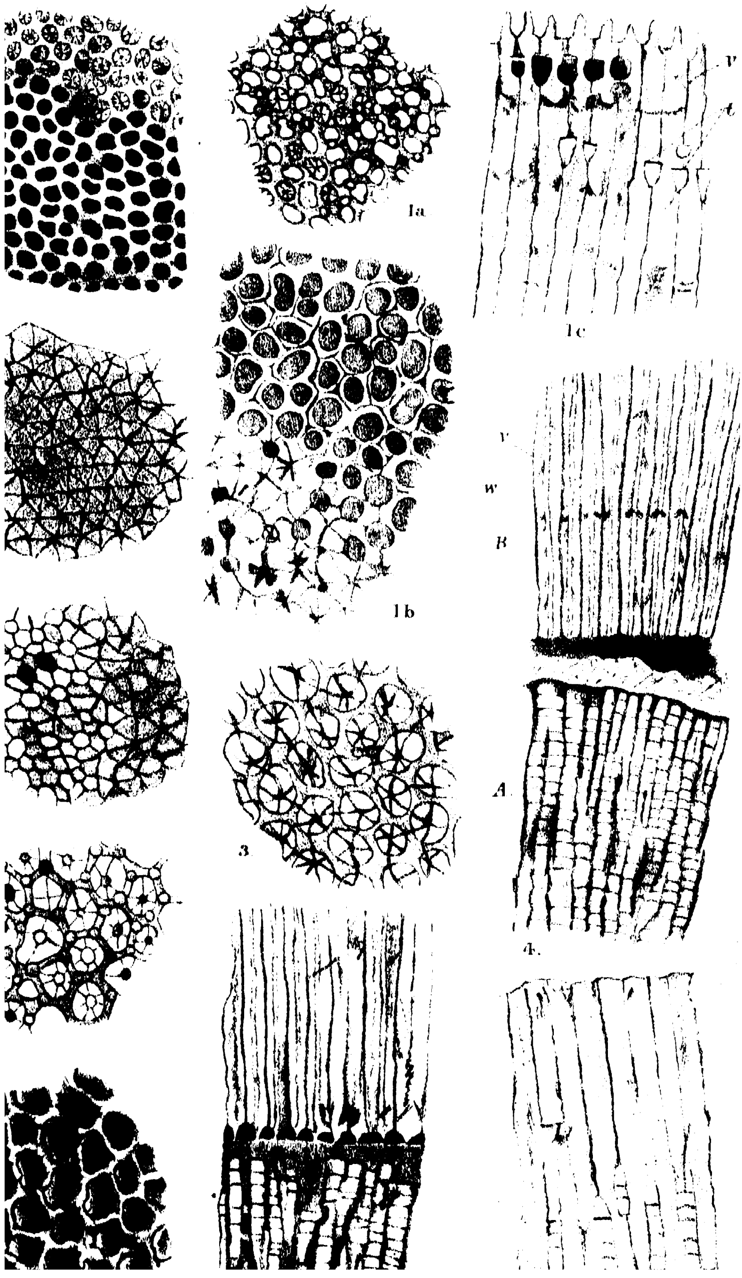
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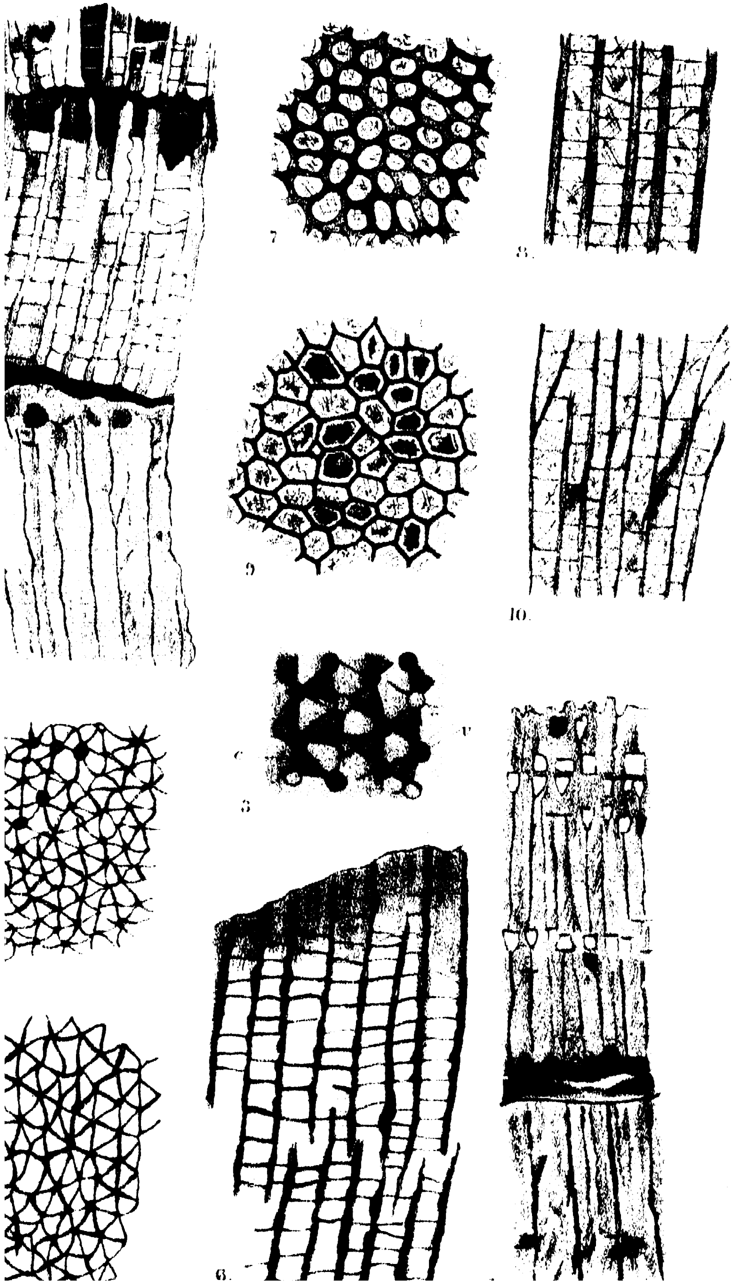
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